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DREDGED MATERIAL RESEARCH PROGRAM.(U)
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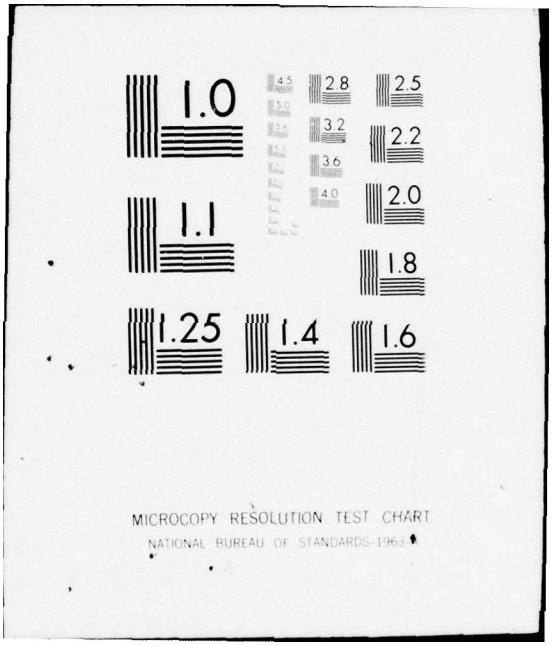
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Dredged Material Research Program

FOURTH ANNUAL REPORT

January 1977

Environmental Effects Laboratory
U. S. Army Engineer
Waterways Experiment Station
CORPS OF ENGINEERS
Vicksburg, Mississippi

LOCAL NEWS

THE MOBILE REGISTER

MOBILE, FAIRHOPE, CHICKASAW, SARALAND, ALA., TUESDAY MORNING, MARCH 23, 1971

Problems of disposing of spoil demonstrated

THE DAILY SUN

Galveston County's Only Afternoon Newspaper

SUNDAY April 25 1976

15 Cents

Engineers growing marsh grass

esearchers join Army Corps

Engineers to study n

man-made island

Habitat studied for beneficial or adverse impact on environment; practicality

LOCAL NEWS

Audubon Naturalist News

Dyke Marsh restoration pla

VOL. 1
NO. 1

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R. T./Saucier, C. C./Calhoun, Jr.,
R. M./Engler, T. R./Patin/H. K./Smith

Corps of Engineers

DREDGED MATERIAL RESEARCH PROGRAM.

Annual rept. no. 4

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Jan 77

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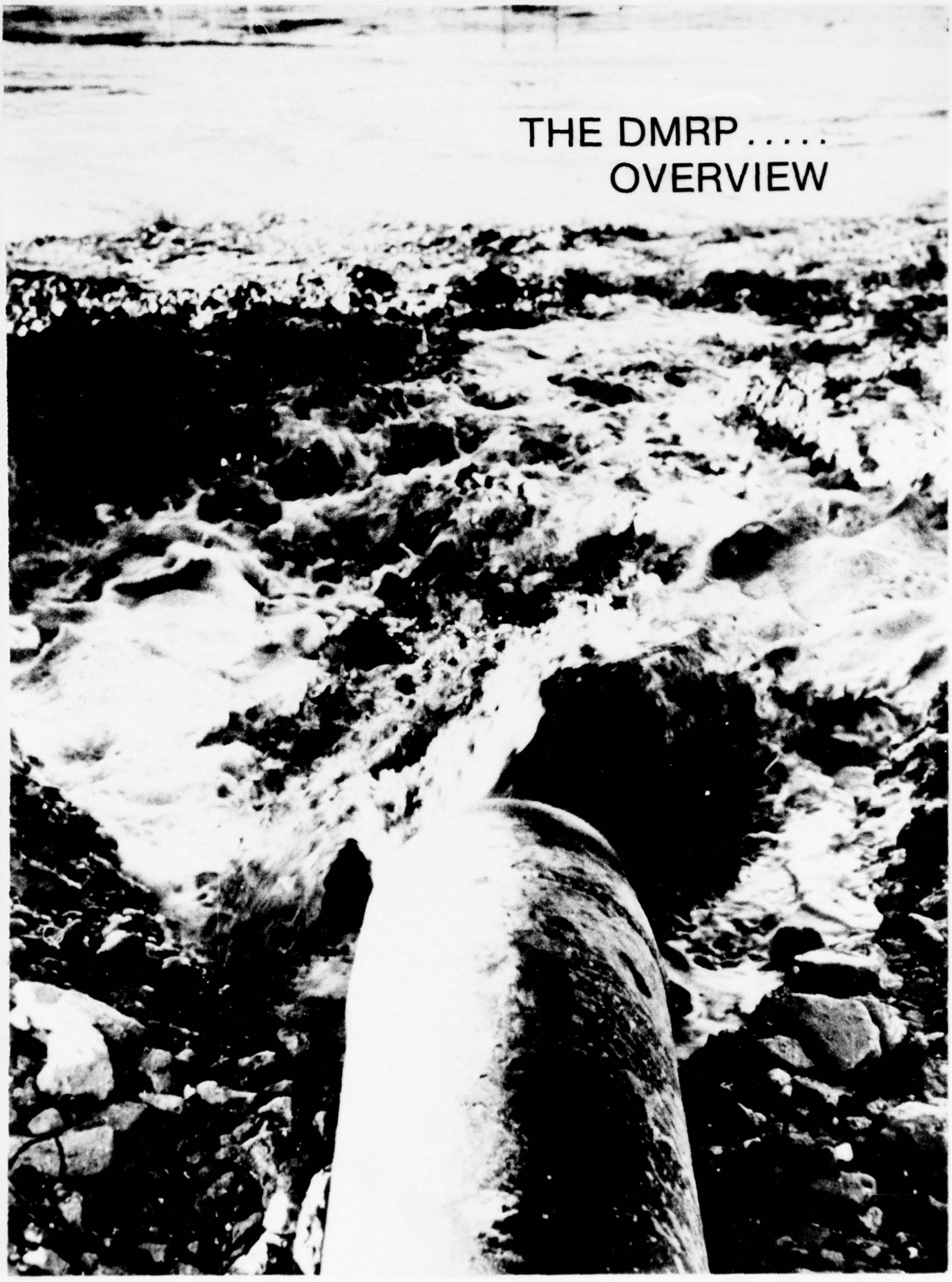
Inquiries regarding the Dredged Material Research Program should be addressed to the U. S. Army Engineer Waterways Experiment Station, ATTN: WESYV, P. O. Box 631, Vicksburg, Mississippi 39180.

THE DMRP.....
OVERVIEW



AUTHORIZATION. . . . .

- By the River and Harbor Act of 1970 (Public Law 91-611, Section 123(i))
- Waterways Experiment Station (WES) assigned in May 1971 to define and assess the problems and develop the research program
- Funding for research authorized by the Office of Management and Budget (OMB) in February 1973
- WES initiated research (Dredged Material Research Program (DMRP)) in March 1973
- Budgets for continuation of research between fiscal years 1974 and 1977 approved incrementally by Congress and OMB on the basis of obtained and anticipated results
- Program to be completed in March 1978

OBJECTIVE. . . . .

The objective of the Dredged Material Research Program is To provide, through research, definitive information on the environmental impact of dredging and dredged material disposal operations and to develop technically satisfactory, environmentally compatible, and economically feasible dredging and disposal alternatives, including consideration of dredged material as a manageable resource.

SPECIFIC GOALS. . . . . > are to: (1)

- Establish definitively the effects of open-water, land, and wetland disposal on water quality and organisms; (2)
- Test and evaluate concepts of marsh development and land and water habitat development as environmentally beneficial disposal alternatives; (3)
- Improve and enhance the acceptance of confined land disposal as an alternative and consider regulation of the dredging/disposal operation as an environmental control measure; and (4)
- Develop and test concepts for using disposal sites for productive purposes and consider the use of dredged material as a natural resource.

A

THE ACTIVITY. . . . .

THE PROBLEM. . . . .

THE SOLUTION. . . . .

These three headings were used in each of the previous Annual Reports of the DMRP as a means of introducing the program and explaining its *raison d'etre.* To avoid repetition and be able to devote fullest attention and space to what is now of greater significance i.e., the growing body of results—this discussion will be omitted and the unaware, interested reader is referred to the previous reports. Be it sufficient to say that:

THE ACTIVITY involves the removal of hundreds of millions of cubic metres of sediment and rock by dredging to create and maintain facilities for waterborne commerce and recreation,

THE PROBLEM lies in the environmental effects of disposing of these huge volumes of material in water, on land, or in wetlands, and the cost-effectiveness of often unproven mitigative measures, and

THE SOLUTION involves developing a predictive capability for effects based on an understanding of mechanism and processes, and a wider selection of tested and proven alternatives

MANAGEMENT. . . . .

The DMRP continues to be managed under a project manager organizational structure within the Environmental Effects Laboratory (EEL) of the WES. Four Project Managers (see Staff section) with technical support staffs are responsible for technical planning, fiscal management, internal and external coordination, technical monitoring of work accomplishment, documentation and reporting, results evaluation and synthesis, and information dissemination and technology transfer. Coordination and overall guidance of the DMRP projects is by an EEL Special Assistant who reports directly to the chief of the EEL. The authority and responsibility for final decisions on all actions taken to meet program objectives are vested in the Program Planning Group (PPG) that consists of all DMRP senior management personnel and the program coordinators.

In addition to implementation of certain research efforts and contract management, EEL technical elements contribute heavily toward the planning and management of all DMRP major field investigations. During 1976, the Environmental Resources Division of EEL devoted about 15 man-years of effort to field site management and are responsible for the compilation, interpretation, and synthesis of field study results.

THE STAFF. . . . .

As the end of calendar year 1976, the primary management staff of the DMRP consisted of:

THE CHIEF, EEL

John Harrison, Ph. D., Supv Research Civil Engineer

THE SPECIAL ASSISTANT, DMR

R. T. Saucier, Ph. D., Geographer

THE PROJECT MANAGERS AND STAFFS

ENVIRONMENTAL IMPACTS AND CRITERIA DEVELOPMENT PROJECT

R. M. Engler, Ph. D., Research Soil Scientist

- R. E. Hoeppel, Research Microbiologist
- B. W. Holliday, Oceanographer
- R. K. Peddicord, Ph. D., Marine Ecologist[1]
- R. H. Plumb, Jr., Ph. D., Physical Scientist

HABITAT DEVELOPMENT PROJECT

H. K. Smith, Ph. D., Research Wildlife Biologist

- L. F. Holloway, Ph. D., Research Botanist
- R. T. Huffman, 1LT, CE, Botanist
- M. C. Landin, Biologist

DISPOSAL OPERATIONS PROJECT

C. C. Calhoun, Jr., Research Civil Engineer

- N. C. Baker, Research Civil Engineer
- W. D. Barnard, Ph. D., Oceanographer
- T. A. Haliburton, Ph. D., Geotechnical Engineering Consultant[2]
- M. L. Hayden, Civil Engineer
- T. K. Moore, Sanitary Engineer

PRODUCTIVE USES PROJECT

T. A. Patin, Civil Engineer[3]

THE COORDINATORS

CORPS/INTERAGENCY COORDINATOR

M. D. Malkasian, MAJ, CE, Civil Engineer

U. S. FISH AND WILDLIFE SERVICE

K. O. Allen, Ph. D., Fishery Biologist[4]

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1 Assigned to WES under an Intergovernmental Personnel Act agreement with the University of California, Berkeley.

2 Assigned to WES under an Intergovernmental Personnel Act agreement with Oklahoma State University.

3 Replaced MAJ R. M. Meccia as Project Manager in December 1976 upon reassignment of MAJ Meccia.

4 Assigned to WES for a 2-year period under an agreement with the U. S. Fish and Wildlife Service.

During 1976, the DMRP management staff lost the services of LTC F. H. Griffis, Jr., who was reassigned overseas; S. E. Palmer, who transferred to another Corps office; L. J. Hunt who transferred to another EEL function; and M. R. Walsh, who is pursuing a program of advanced education.

Management of the major DMRP Aquatic Disposal and Habitat Development field investigations, including development and implementation of research designs and rationales, coordination, and interpretation and reporting of results, has been provided by personnel of the Environmental Monitoring and Assessment Branch (P. R. Becker, Ph. D., Research Biologist, Chief)[5] and the Natural Resources Development Branch (W. B. Gallaher, Ph. D., Research Biologist, Chief),[6] respectively, of the Environmental Resources Division of EEL (C. J. Kirby, Ph. D., Supervisory Research Ecologist, Chief).

The following individuals were accomplishing the indicated functions as of the end of 1976:

H. H. Allen, Research Ecologist (Bolivar Peninsula Site management)

C. R. Bingham, Limnologist (biological data analysis)

C. G. Boone, Oceanographer (Columbia River Site management)

J. S. Boyce, Ph. D., Soil Scientist (Buttermilk Sound and Miller Sands Sites management; soils and soil/plant relationship data analysis)

E. J. Clairain, Fishery Biologist (aquatic biology/fishery studies coordination and data analysis)

S. P. Cobb, Marine Biologist (Ashtabula Site management; coordination of report preparation and review)

R. A. Cole,[7] Ph. D., Research Ecologist (ecological design and data quality control)

P. L. Doiron, Mathematician (data management and analysis)

M. A. Granat, Geologist (physical and geological data analysis)

L. J. Hunt, Wildlife Biologist (Nott Island Site management; Habitat Development Site coordinator; upland habitat data analysis)

J. H. Johnson, Research Limnologist (Duwamish Waterway Site management)

J. D. Lunz, Marine Biologist (Windmill Point Site management; water chemistry and aquatic biology data analysis)

A. D. Magoun, Statistician (data management and analysis)

J. R. Reese, Microbiologist (Eatons Neck Site management)

T. D. Wright,[8] Ph. D., Research Biologist (Galveston Site management)

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5 In August 1976, replaced R. C. Solomon, Research Biologist, as Chief and who is now a Special Assistant, Environmental Resources Division.

6 In April 1976, replaced T. J. Wood, Ph. D., Water Resources Specialist, as Chief and who has accepted employment elsewhere.

7 Assigned to WES under an Intergovernmental Personnel Act agreement with Michigan State University.

8 Assigned to WES under an Intergovernmental Personnel Act agreement with Michigan Technological University.

Management of Task 5C "Disposal Area Reuse" has been carried out by personnel of the Design and Concept Development Branch (DCDB) under the direct supervision of Mr. Raymond L. Montgomery, Supervisory Resident Civil Engineer, Chief. The DCDB is part of the Environmental Engineering Division, Mr. A. J. Green, Supervisory Resident Sanitary Engineer, Chief. The following individuals participated in the planning and implementation of Task 5C:

Mr. Michael J. Bartos, Jr., Civil Engineer
Mr. Alfred W. Ford, Electrical Engineer
Mr. Dale A. Goss, Civil Engineer
Mr. Michael R. Palermo, Research Civil Engineer

During 1976, the following individuals were involved in aspects of site management; however, they accepted employment elsewhere or were on leave of absence as of the end of the year:

D. M. Mathis, Marine Biologist (Galveston Site management)
E. P. Peloquin, Wildlife Ecologist (Miller Sands Site management)
J. R. Seelye, Ph. D., Limnologist (Ashtabula Site management)
J. E. Unsicker, Ph. D., Botanist (botanical data analysis)
D. A. Wright, Civil Engineer (engineering data analysis)

FUNDING. . . . .

Total funding to date for the DMRP, including the Fiscal Year 1977 budget, has amounted to $30,978,000 in yearly increments as follows:

- FY 73 - $1,300,000
- FY 74 - $3,900,000
- FY 75 - $8,200,000
- FY 76 - $9,400,000
- FY 7T - $2,685,000
- FY 77 - $5,493,000

With an anticipated final appropriation for the first half of Fiscal Year 1978, the total for the DMRP will approximate $32,800,000.

As of the end of calendar year 1976, total expenditures and obligations for research have involved 79% of each dollar while the remaining 21% has been used for management and related activities (planning, supervision, contract and field study management, coordination, consultation, travel, reports preparation and publication, information transfer, etc). By the end of the DMRP, the management portion of the dollar is expected to increase by several percentage points since from the present time on, research accomplishment will be decidedly subordinate to information interpretation, documentation, and transfer.

Referring to the specific goals of the DMRP (page 5), distribution of the research dollar has involved:

- 43% for studies of the environmental effects of disposal operations
- 26% for testing and evaluating concepts of marsh and wildlife habitat development
- 25% for studies related to improving land disposal as an alternative and regulation of the disposal operation
- 6% for developing and testing concepts of productive uses of dredged material

RESEARCH ACCOMPLISHMENT. . . . .

Diversity in regard to those individuals and groups implementing the DMRP, achieved to a large extent through competitive advertisement of items of work, continues to be a strongpoint of the program and has led to high levels of research quality and credibility. The more than 200 individual studies (work units) in the DMRP have been or are being accomplished by 42 commercial firms, 30 universities or university-affiliated institutes, 11 offices of 6 Federal and one state agency, 6 individuals, 2 other Corps Laboratories, 7 Corps Districts, and 5 WES organizational elements.

As of 31 December 1976, the status of the DMRP can be summarized as follows:

CATEGORY	NO. OF WORK UNITS	TOTAL COST
Completed Work Units*		
In-house (WES) or Corps	52	$ 3,863,400
Contracts with commercial firms	42	2,661,400
Contracts with universities/institutes	46	4,884,300
Other Federal agencies	8	291,900
	148	11,701,000
Active Work Units		
In-house (WES) or Corps	28	2,302,100
Contracts with commercial firms	23	1,867,500
Contracts with universities/institutes	28	3,620,600
Other Federal agencies	9	1,097,400
	88	8,887,600
Program Totals	236	$20,588,600

* Indicates research completed–final reports being reviewed, revised, in publication, or published.

During calendar year 1976, the research effort increased by 72 work units and in the amount of $6,818,800, the largest yearly amount in the program. The total of 236 work units is, as of the end of the year, within 25 of the total expected for the entire DMRP; a substantial number of the remaining ones will be efforts devoted to data/result summarization or synthesis.

TECHNICAL STRUCTURE. . . . .

No changes in the DMRP technical structure were made during 1976. The 4 projects, subdivided into 20 tasks (representing discrete objectives) as shown below, have proven to be adequate for both technical classification and management and will remain unchanged for the balance of the program.

RESEARCH PROJECTS	RESEARCH TASKS
ENVIRONMENTAL IMPACTS AND CRITERIA DEVELOPMENT	1A Aquatic Disposal Field Investigations 1B Movements of Dredged Material 1C Effects of Dredging and Disposal on Water Quality 1D Effects of Dredging and Disposal on Aquatic Organisms 1E Pollution Status of Dredged Material 2D Confined Disposal Area Effluent and Leachate Control
HABITAT DEVELOPMENT	2A Effects of Marsh and Terrestrial Disposal 4A Marsh Development 4B Terrestrial Habitat Development 4E Aquatic Habitat Development 4F Island Habitat Development
DISPOSAL OPERATIONS	2C Containment Area Operations 5A Dredged Material Densification 5C Disposal Area Reuse 6B Treatment of Contaminated Dredged Material 6C Turbidity Prediction and Control
PRODUCTIVE USES	3B Upland Disposal Concepts Development 4C Land Improvement Concepts 4D Products Research 5D Disposal Area Land Use Concepts
	9A Research Results Applications

CONSULTANTS. . . . .

The DMRP has made liberal and effective use of consultants at all levels and for a variety of purposes ranging from overall program review and guidance and the planning of entire tasks to the preparation of specific scopes of work and the review of reports. Of the more than two dozen scientists and engineers representing academia, industry, government, and research that have been retained, the following 7 individuals have provided continued critique and advice on program-level progress and plans:

- Richard H. Backus, Ph. D. (Marine Biologist), Woods Hole Oceanographic Institution
- Robert S. Clas (Dredging Consultant), Robert Clas & Associates
- Arthur W. Cooper, Ph. D. (Plant Ecologist), North Carolina State University
- G. Fred Lee, Ph. D. (Environmental Chemist), University of Texas at Dallas
- John Lowe III (Soils Engineer), Tippets-Abbett-McCarthy-Stratton, Inc.
- William H. Patrick, Jr., Ph. D. (Soil/Sediment Chemist), Louisiana State University
- Thomas G. Scott, Ph. D. (Zoologist), U. S. Fish and Wildlife Service

COORDINATION. . . . .

- Full-time coordinator staff positions
- Semiannual Interagency Briefings
- Dredging Industry Coordinating Committee
- EPA/Corps Technical Committee on Criteria Development
- Conference sessions and presentations
- Membership on boards, committees, panels, etc.
- Briefings. . . . .

In addition to distribution of information in printed form (see PUBLICATIONS Section, page 16), the activities stated above continue at an accelerating rate and constitute the principal means of DMRP coordination with outside agencies, groups, and interests. Collectively they constitute an extraordinary effort in coordination and communication with primary objectives being to provide awareness of research goals and avoidance of undesirable overlap of activities. However, in keeping with the phasing of the DMRP (i.e., essential completion of research planning and rapid expansion in results attainment), coordination activities more and more are fulfilling another objective–information and technology transfer. All of the activities listed above are serving to meet this objective and have been supplemented with:

- Cooperative projects with Corps Districts
- Corps Division-area briefings/workshops on a monthly rotational basis
- Direct assistance to Corps Districts in project planning

PUBLICATIONS. . . . .

- 12 Information Exchange Bulletins (DMRP total to date = 41)
- 7 Technical Reports (DMRP total to date = 9)
- 9 Contract Reports (DMRP total to date = 24)
- 7 Miscellaneous Papers (DMRP total to date = 11)

A comparison of the number of reports in each category listed above published in 1976 with the DMRP totals quickly indicates a major increase in the pace of reporting research results. However, the bulk of information in printed form is yet to come. During 1976, detailed plans were made for the form and scheduling of all remaining DMRP reports during 1977 and 1978, and these include:

- 31 Technical Reports
- 70 Contract Reports
- 13 Field Site Reports
- 24 Synthesis Reports
- 16+ Information Exchange Bulletins

In addition, plans are being made for a single document summary of the entire DMRP and a comprehensive index and retrieval system.

In keeping with the intent in this Annual Report to organize the presentations along the lines of the major objectives, all reports published to date are listed by the appropriate task. No single comprehensive list is included herein; however, one is available upon request to the DMRP, WES.

The publications policy of the DMRP calls for unlimited free distribution of the Information Exchange Bulletin to all who request to be placed on the mailing list and restricted automatic distribution of Technical Reports and Contract Reports mainly to Corps offices, other Federal agencies, and selected organizations and individuals. Announcements of the availability of all DMRP reports are published in the Bulletin and copies of the reports are available free of charge to any requestor as long as supplies last. When supplies are exhausted, unlimited copies are available for purchase in either microfiche or paper copy form from the National Technical Information Service (NTIS), Springfield, VA 22151.

RELATED ACTIVITIES. . . . .

The application of DMRP research results and the experience and expertise of its staff to the development and implementation of technical criteria and guidelines for the Corps' regulatory functions continued during 1976 to be one of the best examples of DMRP technology transfer. Coordination of DMRP research relevant to the disposal of dredged or fill material in both oceanic and inland waters (Public Laws 92-532 and 92-500) with that being done elsewhere within the Corps and the Environmental Protection Agency (EPA) continued via the EPA/CE Technical Committee on Criteria for Dredged and Fill Material. In addition to research coordination, substantial contributions were made to two other Committee objectives, i.e., providing technical guidance for criteria revision and refinement, and development of implementation manuals. Efforts of DMRP and WES staff members with regard to the former were focused on the criteria for Section 103 (P.L. 92-532) and, with regard to the latter, on the preparation and publication of interim guidance for Section 404 (P.L. 92-500). The specific report involved is:

> Environmental Effects Laboratory, "Ecological Evaluation of Proposed Discharge of Dredged or Fill Material into Navigable Waters," Miscellaneous Paper D-76-17, May 1976, U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Mississippi.

Specific research activities within the DMRP applicable to technical criteria and guidelines development are largely included under Task 1E: Pollution Status of Dredged Material (see page 55). Supplemental work is in progress within EEL under sponsorship of the Office, Chief of Engineers, and includes the following specific work units:

- The Long-Term Release of Contaminants from Dredged Material. EEL/WES. $50,000. Active.
- Development of Bioassay Methodologies Using Selected Benthic Organisms. EEL/WES. $173,000. Active.
- Field Testing and Verification of Dredged Material Disposal Criteria. University of Texas at Dallas. $104,471. Active.
- Development of Time-Dilution Dredged Material Bioassay Using Zooplankton. Stanford Research Institute. $93,579. Active.
- An Assessment of Problems Associated with Evaluating the Physical, Chemical and Biological Impacts of Discharging Fill Material. University of Oklahoma. $91,666. Active.
- Flume Experiments on Critical Erosion Velocities, Shear Stress and Sediment Transport of Sand, Silt and Clay Mixtures from the Offshore Dredged Material Disposal Site, Galveston, Texas. Texas A&M University. $9,974. Active.

THE CONTRACTORS. . . . .

Acres American, Inc., Buffalo, New York (D. W. Lamb)

Adriaan Volker Dredging Company, Rotterdam, The Netherlands (A. J. Hoekstra and K. d'Angremond)

Agricultural Research Service, North Central Region, St. Paul, Minnesota (W. E. Larson)

American Technical Assistance Corp., McLean, Virginia (D. McDonald)

Argonne National Laboratory, Argonne, Illinois (W. Harrison)

Arthur D. Little, Inc., Cambridge, Massachusetts (F. W. Besley and J. Harrison)

Battelle Columbus Laboratories, Columbus, Ohio (R. Moore)

Beeman/Benkendorf j.v., Portland, Oregon (O. Beeman and A. Benkendorf)

Biological Water Purification, Inc., New York, New York (L. Banks)

Brian J. Gallagher and Co., Milwaukee, Wisconsin (B. J. Gallagher)

University of California Bodega Marine Laboratory, Bodega Bay, California (C. Hand and R. Peddicord)

The University of California at Davis, Davis, California (R. B. Krone)

The Center for the Environment and Man, Inc., Hartford, Connecticut (D. R. Zoellner)

The Citadel, Charleston, South Carolina (W. B. Ezell, Jr.)

Coastal Ecosystems Management, Fort Worth, Texas (R. Parker)

Coastal Zone Resources Corp., Wilmington, North Carolina (D. A. Adams and W. T. Hart)

Cold Regions Research and Engineering Laboratory, Corps of Engineers, Hanover, New Hampshire (S. Blouin, E. J. Chamberlain, and R. P. Murrman)

University of Connecticut Marine Sciences Institute, Groton, Connecticut (F. Bohlen, F. Y. Feng, W. Niering, and B. Welsh)

University of Connecticut, Cooperative Extension Service, Groton, Connecticut (W. Washko)

Connecticut College, Department of Botany, New London, Connecticut (W. Niering and S. Warren)

Connecticut Department of Environmental Protection, Hartford, Connecticut (D. Decarli and T. Linkala)

Construction Engineering Research Laboratory, Corps of Engineers, Champaign, Illinois (E. L. McDowell)

Dames & Moore, Inc., San Francisco, California (C. W. Garbe and E. L. Sembler)

Dauphin Island Sea Laboratory, Dauphin Island, Alabama (J. Stout)

University of Delaware, Newark, Delaware (D. L. Maurer)

Dow Chemical Company, Texas Division, Freeport, Texas (D. C. Mangum and J. A. Quick, Jr.)

Energy Resources Company, Inc., Cambridge, Massachusetts (J. J. Gushue and R. H. Rosen)

Engineering Science, Inc., Austin, Texas (L. F. Tischler)

Envirex, Inc., Milwaukee, Wisconsin (R. E. Wullschleger)

Environmental Concern, Inc., St. Michaels, Maryland (E. Garbisch)

Environmental Engineering Consultants, Stillwater, Oklahoma (R. N. DeVries, A. F. Gandy, D. F. Kincannon)

Environmental Systems Services of Tallahassee, Inc., Tallahassee, Florida (W. L. Kruczynski)

General Research Corporation, McLean, Virginia (T. F. Ferrara)

University of Georgia, Marine Institute, Sapelo Island, Georgia (J. L. Gallagher and R. J. Reimold)

University of Georgia, Marine Resources Extension Center, Brunswick, Georgia (R. J. Reimold)

Hittman Associates, Inc., Columbia, Maryland (H. T. Hopkins and C. W. Mallory)

John Huston, Inc., Corpus Christi, Texas (J. Huston)

The Industrial Biotest Laboratories, Northbrook, Illinois (R. Johnson)

JBF Scientific Corporation, Burlington, Massachusetts (E. E. Johanson, R. W. Neal, and D. S. Yeaple)

JBF Scientific Corporation, Wilmington, Massachusetts (E. E. Johanson)

KMA Research Institute, Phoenix, Arizona (C. E. O'Bannon)

LFE Environmental Analysis Laboratories, Richmond, California (M. Nathans)

Living Marine Resources, Inc., San Diego, California (W. Gayman)

Louisiana State University, Agronomy Department, Baton Rouge, Louisiana (W. H. Patrick, Jr.)

Louisiana State University Center for Wetland Resources, Baton Rouge, Louisiana (J. G. Gosselink)

Louisiana Technological Institute, Ruston, Louisiana (R. P. Jones)

Manomet Bird Observatory, Manomet, Maine (F. G. Buckley)

Massachusetts Institute of Technology, Department of Civil Engineering, Cambridge, Massachusetts (T. W. Lambe, T. L. Neff, and S. M. Lacasse)

University of Michigan, School of Natural Resources, Ann Arbor, Michigan (J. A. Kadlec)

Morgantown Energy Research Center, U. S. Bureau of Mines, Morgantown, West Virginia (D. G. Simpson)

NALCO Environmental Sciences, Burlingame, California (R. Johnson)

National Marine Fisheries Service, National Oceanic and Atmospheric Administration (NOAA), Galveston, Texas (K. N. Baxter and J. M. Lyon)

National Marine Fisheries Service, Northwest Fisheries Center, NOAA, Seattle, Washington (T. Blahm, T. Durkin, and G. T. Snyder)

National Oceanographic Instrumentation Center, NOAA, Rockville, Maryland (R. Farland)

Naval Construction Battalion Center, Civil Engineering Laboratory, Port Hueneme, California (R. N. Thomas)

State University of New York, The Great Lakes Laboratory, Buffalo, New York (R. Sweeney)

New York Ocean Science Laboratory, Montauk, New York (D. K. Serafy)

State University of New York at Stony Brook, Marine Science Research Center, Stony Brook, New York (H. H. Carter and J. R. Schubel)

Northwestern Michigan College, Traverse City, Michigan (W. Scharf)

Northwestern University, The Technological Institute, Evanston, Illinois (R. J. Krizek)

Oak Ridge National Laboratory, Oak Ridge, Tennessee (N. H. Cutshall)

Old Dominion University, Institute of Oceanography, Norfolk, Virginia (D. Adams)

Old Dominion University, School of Engineering, Norfolk, Virginia (R. Y. K. Cheng)

Office of Naval Research, Naval Medical Research Laboratory, Oakland, California (L. H. DiSalvo, R. J. Heckly, and N. A. Vedros)

Oregon State University, School of Oceanography, Corvallis, Oregon (A. J. Carey, Jr., J. Crawford, R. Holton, and H. N. Small)

Oregon State University, Department of Fisheries and Wildlife, Corvallis, Oregon (J. A. Crawford)

Roy Mann Associates, Cambridge, Massachusetts (R. Mann and W. A. Niering)

Ryckman/Edgerley/Tomlinson and Associates, Inc., St. Louis, Missouri (J. W. Irvin and B. W. Long)

San Francisco Bay Marine Research Center, San Francisco, California (C. L. Newcombe)

San Jose State University Foundation, San Jose, California (J. W. Nybakken, J. S. Oliver, and P. N. Slattery)

Seabird Research, Inc., Tampa, Florida (R. Lewis and R. Schrieber)

Soil and Material Engineers, Inc., Raleigh, North Carolina (R. R. Beason)

University of Southern California, Department of Environmental Engineering, Los Angeles, California (K. Y. Chen and T. F. Yen)

Stearns, Conrad, and Schmidt Consulting Engineers, Inc., Long Beach, California (J. Mang and D. E. Ross)

Teknekron, Inc., Washington, D. C. (D. M. Speaker)

TerEco, College Station, Texas (W. Pequegnat)

Tetra Tech, Inc., Pasadena, California (D. Divoky and L. Hwang)

University of Texas at Dallas, Institute for Environmental Sciences, Richardson, Texas (G. F. Lee)

Texas A&I University, Kingsville, Texas (A. Chaney and B. Chapman)

Texas Agricultural Experiment Station, The Texas A&M University System, College Station, Texas (B. W. Cain, J. D. Dodd, L. Hossner, and R. R. Stickney)

Texas A&M Research Foundation, College Station, Texas (J. W. Anderson, D. R. Basco, J. M. Neff, and F. Slowey)

Texas A&M University, Oceanography and Meteorology Department, College Station, Texas (A. H. Bouma and G. L. Huebner)

Texas A&M University, Department of Range Science, College Station, Texas (B. W. Cain, J. D. Dodd, L. R. Hossner, and R. R. Stickney)

Texas A&M University, Soil and Crop Science Department, College Station, Texas (K. Brown)

Texas A&M University, Moody College of Marine Sciences and Maritime Resources, Galveston, Texas (D. E. Harper, Jr.)

U. S. Army Engineer District, Galveston, Contracts Branch, Galveston, Texas (D. Dunn)

U. S. Army Engineer District, Galveston, Foundation and Materials Branch, Galveston, Texas (G. Powledge)

U. S. Army Engineer District, Galveston, Survey Branch, Galveston, Texas (A. Graham)

U. S. Army Engineer District, Mobile, Foundation and Materials Branch, Mobile, Alabama (H. Blakeney, B. Chamlee, and P. A. Douglas)

U. S. Army Engineer District, Norfolk, Survey Branch, Norfolk, Virginia (G. Whitehurst)

U. S. Army Engineer District, Portland, Hydrographic Survey Section, Portland, Oregon (N. H. West)

U. S. Army Engineer District, Portland, Soils Section, Portland, Oregon (J. Jenkins)

U. S. Army Engineer District, San Francisco, San Francisco, California (P. Knutson)

U. S. Army Engineer District, Savannah, Foundation and Materials Branch, Savannah, Georgia (D. P. Hammer)

U. S. Army Engineer District, Seattle, Environmental Resources Section, Seattle, Washington (S. Dice)

U. S. Environmental Protection Agency, Environmental Research Laboratory, Marine and Freshwater Ecology Branch, Corvallis, Oregon (D. Baumgartner)

U. S. Environmental Protection Agency, Region X Laboratory, Seattle, Washington (J. N. Blazevich and A. Gahler)

University of Virginia, Department of Environmental Sciences, Charlottesville, Virginia (W. E. Odum, S. S. Skjei, and J. C. Zieman)

Virginia Institute of Marine Science, Gloucester Point, Virginia (D. Boesch, F. Fang, J. Merriner, M. M. Nichols, G. Silberhorn, M. Wass, and R. Wetzel)

Walden Research Division, ABCOR, Inc., Cambridge, Massachusetts (D. R. Cogley)

Wapora, Inc., Washington, D. C. (F. H. Khattat)

Washington State University, Western Washington Research and Extension Center, Puyallup, Washington (P. E. Heilman)

University of Washington, College of Fisheries, Seattle, Washington (R. W. Schell)

University of Washington, Fisheries Research Institute, Seattle, Washington (E. Salo and Q. J. Stober)

University of Washington, Department of Oceanography, Seattle, Washington (J. Creager and S. Pavlou)

Wave Beach Grass Nursery, Florence, Oregon (W. Ternyik)

University of Wisconsin at LaCrosse, LaCrosse, Wisconsin (J. Held and S. H. Sohmer)

Woodward-Clyde Consultants, Portland, Oregon (C. D. White)

Yale University, Department of Geology and Geophysics, New Haven, Connecticut (R. Gordon)

WES or In-House–

Ecosystem Research and Simulation Division, Environmental Effects Laboratory (J. M. Brannon, T. B. Delaney, Jr., R. L. Eley, D. Gunnison, R. E. Hoeppel, P. G. Hunt, C. R. Lee, P. J. Shuba, and R. M. Smart)

Engineering Geology and Rock Mechanics Division, Soils and Pavements Laboratory (J. D. Broughton, W. K. Dornbusch, W. L. Murphy, and T. W. Zeigler)

Engineering Sciences Division, Concrete Laboratory (D. L. Ainsworth)

Environmental Engineering Division, Environmental Effects Laboratory (M. J. Bartos, Jr., A. W. Ford, N. R. Francingues, R. L. Montgomery, T. K. Moore, and M. R. Palermo)

Environmental Systems Division, Mobility and Environmental Systems Laboratory (E. E. Addor, A. M. Dean, Jr., J. L. Decell, J. K. Stoll, and H. W. West)

Material Development Division, Soils and Pavements Laboratory (C. R. Styron III)

Mathematical Hydraulics Division, Hydraulics Laboratory (M. B. Boyd and B. H. Johnson)

Mobility Systems Division, Mobility and Environmental Systems Laboratory (C. E. Green and W. E. Willoughby)

Soil Dynamics Division, Soils and Pavements Laboratory (J. Fowler and J. W. Spotts)

Soil Mechanics Division, Soils and Pavements Laboratory (D. P. Hammer, L. D. Johnson, and J. W. Spotts)

Soils and Pavements Laboratory (R. W. Cunny and S. J. Johnson)

Structures Division, Hydraulics Laboratory (B. Loftis)

Individuals–

Dr. Fred Grupp, Storrs, Connecticut

Dr. Ronald Philips, Bellevue, Washington

Ms. Sue Richardson, Vicksburg, Mississippi

Mr. Jack Rogers, Corvallis, Oregon

Dr. R. W. Rountree, Syracuse, New York

Dr. H. L. Windom, Savannah, Georgia

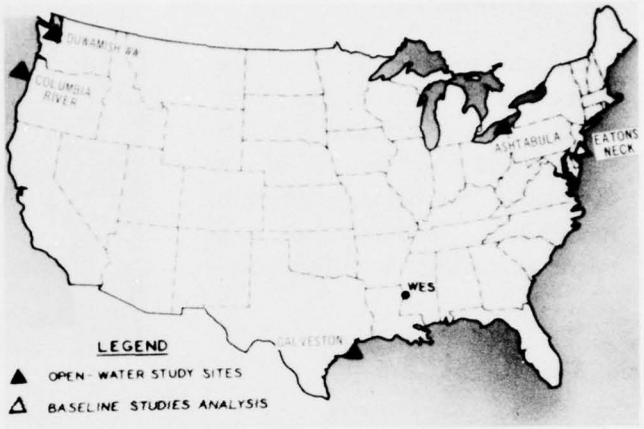
DETAILED STATUS

AQUATIC DISPOSAL FIELD INVESTIGATIONS

(Task 1A: Environmental Impacts and Criteria Development Project)

OBJECTIVE. . . . .

— to determine the magnitude and extent of effects of disposal sites on organisms and the quality of surrounding water, and the rate, diversity, and extent such sites are recolonized by benthic flora and fauna—



APPROACH. . . . .

— *select active sites representative of different regions* and disposal situations; develop monitoring strategies and sampling and analytical plans; conduct monitored, controlled disposal operations and compare results to baseline conditions and reference sites; evaluate results in terms of hypotheses and lab study findings of other tasks—

STATUS. . . . .

— 29 total work units (6 in-house efforts, 16 contracts, 7 interagency agreements) involving an aggregate expenditure/obligation of $4,657,630.

— bulk of effort (20 work units) expended at 5 major field sites; disposal operations completed at each site and data being analyzed.

— 15 work units completed and 14 work units active;* 2 reports published and 1 report in press.

— all field site study results to be presented in 5 site reports; other final results to be presented in 2 additional reports and 1 synthesis document.

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* For the purpose of this report, a work unit was considered active until the final draft report was accepted.

THE FIELD SITES. . . . .

EATONS NECK (New York):

Objective and Approach—

—through before-, during-, and after-disposal monitoring of physical, chemical, and biological parameters, assess the impacts of the disposal of mechanically dredged, fine-grained, contaminated sediments at an estuarine disposal site—

Results and Findings to Date—

SHORT-TERM IMPACTS. No acute effects could be assessed since the study was terminated prior to the scheduled disposal operation because of local opposition to disposal-related research in Long Island Sound.

LONG-TERM IMPACTS. Baseline studies at the site failed to reveal any significant cumulative impacts of the historic disposal activities other than a change in bottom geometry. From a biological point of view, this change may have been instrumental in enhancing the lobster fishery of the area.

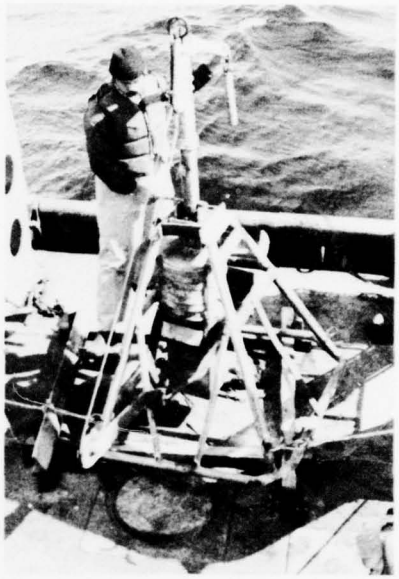
Work Units—

1A06A An Investigation of the Hydraulic Regime, the Meteorology, and the Physical Nature of Bottom Sedimentation in the Eatons Neck Disposal Site. Yale University. $145,390. Completed: to be published as appendix to site report.

1A06B An Investigation of the Water-Quality Parameters and the Physicochemical Sediment Parameters at the Eatons Neck Disposal Site. State University of New York at Stony Brook. $284,115. Completed: to be published as appendix to site report.

1A06C Baseline Studies of Plankton, Nekton, and Benthic Invertebrate Populations of the Eatons Neck Disposal Site. New York Ocean Science Lab. $264,717. Completed: to be published as appendix to site report.

COLUMBIA RIVER (Oregon):



Objective and Approach–

–evaluate the acute and long-term effects of on-shelf oceanic hopper dredge disposal of coarse-grained dredged material at a regionally representative disposal site off the mouth of the Columbia River–

Results and Findings to Date—

SHORT-TERM IMPACTS. Chemical analysis of the water column suggests that there were no discernible effects associated with the discharge of approximately 600,000 cubic yards of dredged material. Acute biochemical effects appear to be insignificant and intermediate-term chemical mobilization from the dump site was not detected. Physical mounding of the material was evident at this site.

LONG-TERM IMPACTS. Biological investigations suggest slow recolonization (1 to 3 years to biological stability) of the coarse-grained material by organisms native to the area. No biochemical/contaminant impacts are expected at this site. Long-term water column and benthic biota investigation reports are being prepared at this time; consequently, final interpretation of results is not available.

Work Units—

1A07A An Investigation of the Hydraulic Regime, the Meteorology, and the Physical Nature of Bottom Sedimentation in the Columbia River Disposal Site. University of Washington. $286,262. Completed: draft report in preparation: to be published as appendix to site report.

1A07B An Investigation of the Water-Quality Parameters and the Physicochemical Sediment Parameters at the Columbia River Disposal Site. Oregon State University. $264,890. Completed: draft report in preparation: to be published as appendix to site report.

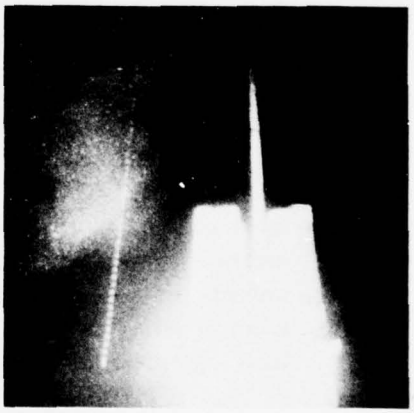
1A07C Baseline Studies of Benthic Invertebrate Populations at the Columbia River Disposal Site. Oregon State University. $251,412. Completed: draft report in preparation: to be published as appendix to site report.

1A07D Baseline Studies of Plankton Population at the Columbia River Disposal Site. Oregon State University. $94,135. Completed: draft report in preparation: to be published as appendix to site report.

1A07E Baseline Studies of Fisheries at the Columbia River Disposal Site. Northwest Fisheries Center, National Marine Fisheries Service, NOAA. $114,522. Completed: draft report in preparation: to be published as appendix to site report.

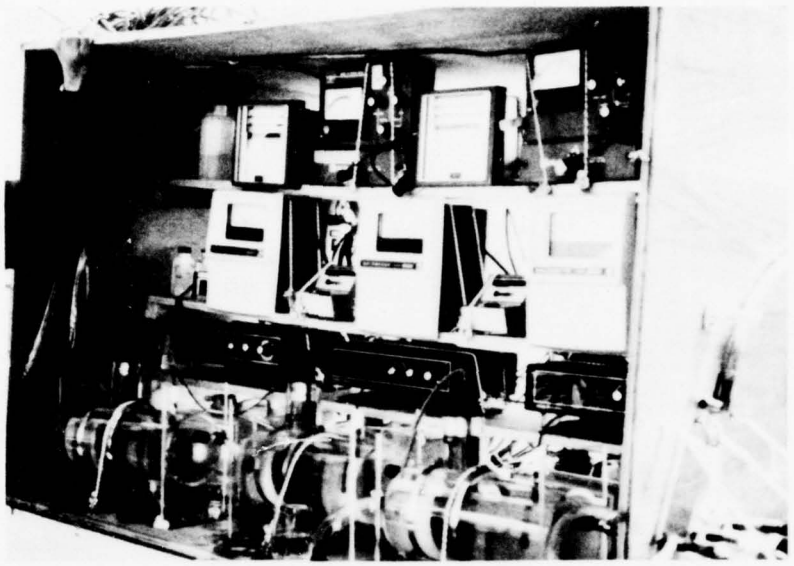
1A07F Assistance of Portland District Personnel for the Oregon State University Research Team. Portland District. $8,000. Completed: no report.

LAKE ERIE (Ashtabula, Ohio):



Objectives and Results—

—to contrast spring and summer hopper dredge disposal of contaminated and noncontaminated harbor sediment on a freshwater aquatic system; ascertain the long-term biochemical impacts at a historical dump site in Lake Erie off Ashtabula Harbor, Ohio—



Results and Findings to Date—

SHORT-TERM IMPACTS. Release to the water column of orthophosphate, ammonium, and reactive silica occurred at disposal. The water column returned to ambient within a few hours. No metals or hydrocarbons were released and only a small level of suspended particulates could be detected. No impacts of the plankton community were noted. Fish were neither attracted to nor avoided the dumping operation. Physical mounding at the site was evident.

LONG-TERM IMPACTS. The disposal mound has significantly decreased in size, suggesting sediment consolidation and erosion. The magnitude of sediment resuspension-transport is not known at this time. The benthic fauna were impacted during disposal; however, recolonization has been rapid. Release of contaminants from the disposal mound was not detected. Data evaluation for the long-term benthic studies is incomplete at this time.

Work Units—

1A08A, 1A08C — An Investigation of Planktonic Communities, Benthic Assemblages, and the Fishery Associated with the Ashtabula Harbor Disposal Sites; and An Investigation of the Water-Quality Parameters and the Physicochemical Sediment

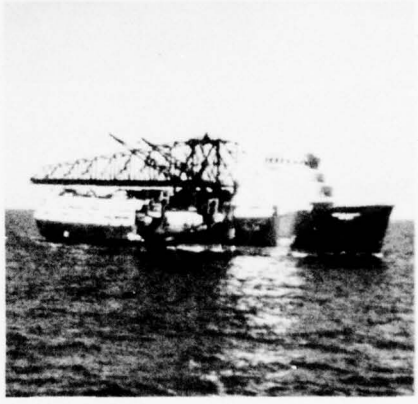
Parameters in the Ashtabula Harbor Disposal Site. Great Lakes Laboratory, State University of New York at Buffalo. $641,938. Completed: draft reports in preparation: to be published as appendix to site report.

1A08B An Investigation of the Hydraulic Regime and the Physical Nature of Bottom Sedimentation Associated with the Ashtabula Harbor Disposal Site. NALCO Environmental Sciences. $254,075. Completed: draft report in preparation: to be published as appendix to site report.

GULF OF MEXICO (Galveston, Texas):

Objectives and Approach–

–investigate impacts of open Gulf discharge of hopper dredged noncontaminated fine-grained and coarse-grained material from the Galveston Bay entrance bar and highly contaminated sediments from the Texas City ship channel; emphasis placed on acute impacts from the fine-grained material and benthic recolonization of the dump site–



Results and Findings to Date—

SHORT-TERM IMPACTS. Water column impacts were short lived. Ammonium and manganese were released from the contaminated material and remained for less than a few hours. Summer disposal caused no apparent change in the infaunal species composition or relative abundance at the dump site. Late winter-early spring disposals are still being evaluated.

LONG-TERM IMPACTS. Due to a rapidly changing hydrodynamic regime, the bottom geometry of the dump site is continuously changing, leaving only the coarsest grained material and some clay that is resistant to erosion. Benthic organism impacts are currently being evaluated.

Work Units—

1A09A An Investigation of the Hydraulic Regime and Physical Nature of Sedimentation at the Galveston Disposal Site. Texas A&M Research Foundation. $178,752. Completed: draft report in preparation: to be published as appendix to site report.

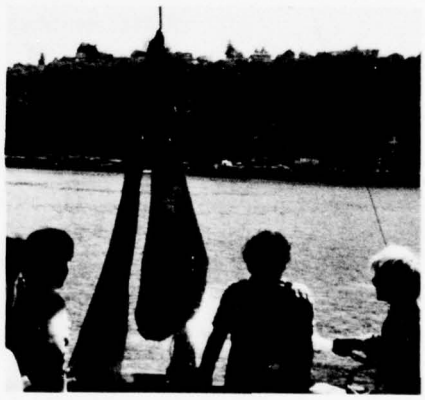
1A09B An Investigation of the Biota at the Galveston Disposal Site. Moody College of Marine Sciences and Maritime Resources, Texas A&M University. $169,507. Completed: draft report in preparation: to be published as appendix to site report.

1A09C An Investigation of the Water-Quality Parameters and Physicochemical Parameters at the Galveston Disposal Site. University of Texas at Dallas. $176,220. Completed: draft report in preparation: to be published as appendix to site report.

1A09D Assistance of Galveston District. Galveston District. $26,226. Completed: no report.

DUWAMISH WATERWAY (Puget Sound, Washington):

Objectives and Approach—



—to investigate the disposal in an estuarine location of fine-grained sediments contaminated with PCBs, metals, and petroleum hydrocarbons. The sediments were dredged mechanically and barged to an Elliott Bay, Puget Sound, site with a depth of 200 feet—

Results and Findings to Date—

SHORT-TERM IMPACTS. Suspended sediment impacts to the water column were of short duration (2 hours) and occurred near the bottom. Dissolved oxygen reductions were less than 1 part per million and lasted less than 30 minutes. Metals were not detected in the water column in dissolved form. PCBs were released at a few parts per trillion and were detected for only a few minutes. Ammonium was released in small quantities for a few minutes. Benthic organism density and biomass were significantly impacted at the time of discharge.

LONG-TERM IMPACTS. Benthic recolonization by a wide range of organisms occurred rapidly (3 to 6 months to return to original biomass) over all areas of the impacted site. There was no elevated uptake of metals or PCBs in crustaceans, bivalves, or flatfish collected on the dump site several months after disposal. Other than the physical impact of the mound at the dump site, impacts of the disposal appear minimal.

Work Units—

1A10A Pilot Survey–Selection of Research Area. National Marine Fisheries Service, NOAA. $23,954. Completed: draft report in review: to be published as appendix to site report.

1A10B Baseline, Disposal, and Postdisposal Biological Studies for the Duwamish Waterway Aquatic Disposal Field Investigation. National Marine Fisheries Service, NOAA. $202,336. Active.

1A10C Baseline, Disposal, and Postdisposal Sediment and Water Chemistry Studies for the Duwamish Waterway Aquatic Disposal Field Investigation. EPA. $299,844. Active.

1A10D Continuation of the Sediment and Water Physicochemical Studies Associated with the Disposal Operation of Duwamish River Sediments in Elliott Bay, Puget Sound, Washington. University of Washington. $114,042. Active.

REPORTS PUBLISHED. . . . .

MP D-75-13
(Work Unit 1B01)

Becker, P. R., Holliday, B. W., Palmer, S. E., and Engler, R. M., "General Research Plan for the Field Investigations of Coastal Dredged Material Disposal Areas," April 1975, Environmental Effects Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A009 523.

CR D-76-3
(Work Unit 3A02)

Johanson, E. E., Bowen, S. P., and George, H., "State-of-the-Art Survey and Evaluation of Open-Water Dredged Material Placement Methodology," April 1976, prepared by JBF Scientific Corporation, Burlington, Massachusetts, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A027 024.

FIELD STUDY SUPPORT EFFORTS. . . . .

1A01 Collection and Assessment of Data on Open-Water Disposal Sites. Interlaboratory Team, WES. $124,785. Completed: Internal Working Document.

OTHER TASK 1A WORK UNITS. . . . .

1A11 An Assessment of the Potential Impact of Dredged Material Disposal in the Open Ocean. TerEco. $77,292. Active.

3A01 Investigation of Subaqueous Borrow Pits as Potential Sites for Dredged Material Disposal. Soils and Pavements Laboratory (SPL), WES. $57,400. Completed: final report in press.

3A02 State-of-the-Art Survey and Evaluation of Open-Water Dredged Material Placement Methodology. JBF Scientific Corporation. $70,421. Completed: final report published, CR D-76-3.

1A02 Determination of Benthic Colonization Control Factors. EEL, WES. $18,673. Completed: data input to 1A05.

1A03 Monitoring Equipment, Methodology, and Institutional Capabilities Survey. Mobility and Environmental Systems Laboratory (MESL), WES. $58,324. Completed: Internal Working Document.

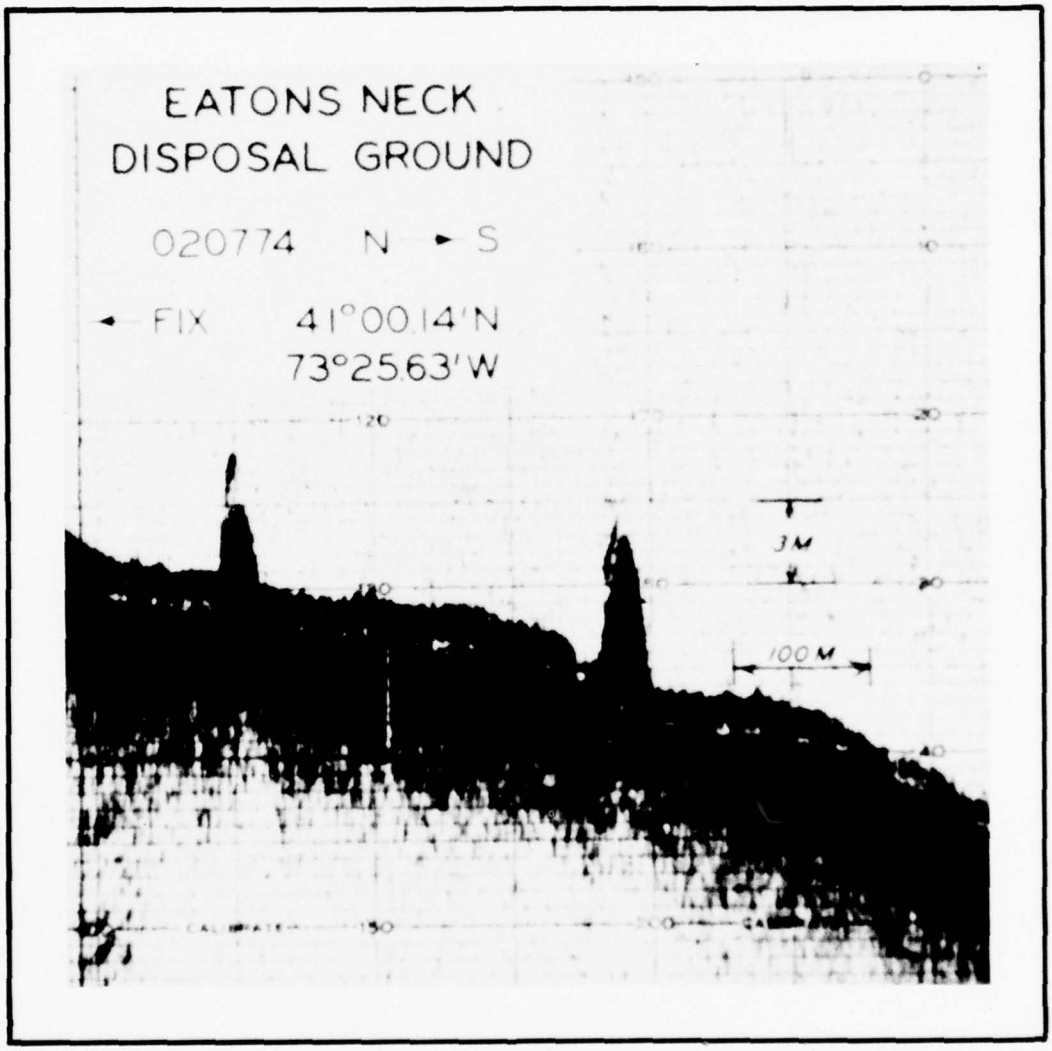
1A03A A Nationwide Calibration, Standardization, and Evaluation of Environmental Monitoring Instrumentation for the Aquatic Disposal Research Project. National Oceanographic Instrumentation Center, NOAA. $95,000. Completed: no report planned.

1A04 Development and Implementation of Information Storage and Retrieval System, EEL Concrete Laboratory (CL), WES. $291,410. Active: user manual completed.

1A05 Selection of Test Sites and Design of Field Studies, Open-Water Dredged Material Disposal Sites. Interlaboratory Team, WES. $63,890. Completed: final report published, MP D-75-13.

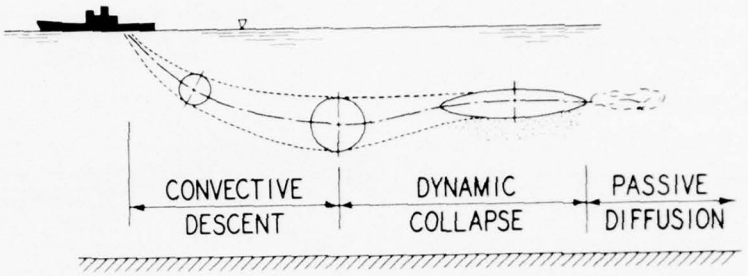
MOVEMENTS OF DREDGED MATERIAL

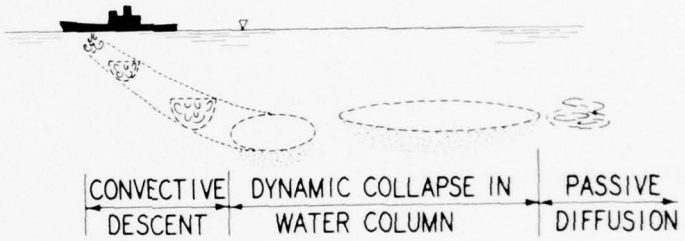
(Task 1B: Environmental Impacts and Criteria Development Project)



OBJECTIVE. . . . .

— to develop techniques for predicting the spatial and temporal distribution of dredged material discharged into various hydrologic regimes—





APPROACH. . . . .

— conduct a thorough evaluation of the current state-of-the-art of numerical models for use in predicting sediment dispersion and transport associated with aquatic discharge of dredged material; select or develop appropriate models or concepts; initiate various sensitivity analyses and field verifications requisite to having a predictive tool for the broadest range of conditions and geographical locations—

STATUS. . . . .

— 9 total work units (4 in-house efforts, 5 contracts) involving an aggregate expenditure/obligation of $585,250.

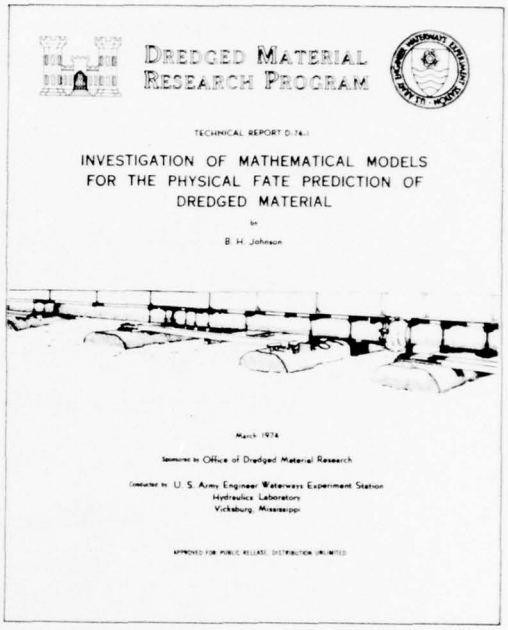
— 4 work units completed and 5 work units active; 3 reports published, and 3 reports being reviewed.

— final results to be presented in 8 contract and technical reports and 2 comprehensive synthesis reports.

RESULTS AND FINDINGS TO DATE. . . . .

Review–

A review and evaluation of existing models for adaptation to dredged material has shown the Koh-Chang model to have the most promise. There was no model available that could be used for prediction of long-term sediment transport from the discharge site. (See Technical Report D-74-1 and Contract Report D-74-8.)


DREDGED MATERIAL RESEARCH PROGRAM

TECHNICAL REPORT D-74-1

INVESTIGATION OF MATHEMATICAL MODELS FOR THE PHYSICAL FATE PREDICTION OF DREDGED MATERIAL

by

B. H. Johnson

March 1974

Sponsored by Office of Dredged Material Research

Conducted by U. S. Army Engineer Waterways Experiment Station
Hydraulics Laboratory
Vicksburg, Mississippi

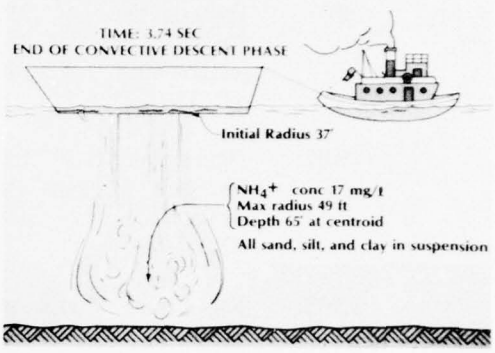
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

Development–

The Koh-Chang dispersion model developed by EPA for the ocean disposal of barged wastes was selected and significantly modified for prediction of the dispersion of dredged material in ocean, estuarine, lacustrine, or riverine environments. Development of a two-dimensional sediment transport model for the long-term and ultimate fate of these deposits was initiated. (See Contract Report D-76-5 and Work Unit 1B05.)

Field Verification–

Field verification of the short-term dispersion model is nearing completion and has demonstrated three steps in the aquatic discharge of dredged material. They are: (1) convective descent; (2) dynamic collapse; and (3) long-term release. There was little release of solid material to the water column and water depth had little effect during descent for hopper and barge disposal. The quantity being discharged had little effect on bottom placement. A general conclusion was that the three-step process allows for accurate deposition under a range of conditions. (See Work Units 1B07 and 1B09.)



REPORTS PUBLISHED. . . . .

TR D-74-1
(Work Unit 1B01)

Johnson, B. H., "Investigation of Mathematical Models for the Physical Fate Prediction of Dredged Material," March 1974, Hydraulics Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD 776 368.

CR D-74-8
(Work Unit 1B04)

Basco, D. R., Bouma, A. H., and Dunlap, W. A., "Assessment of the Factors Controlling the Long-Term Fate of Dredged Material Deposited in Unconfined Subaqueous Disposal Areas," December 1974, prepared by Texas A&M University, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A009 127.

CR D-76-5
(Work Unit 1B02)

Brandsma, M. G., and Divoky, D. J., "Development of Models for Prediction of Short-Term Fate of Dredged Material in the Estuarine Environment," May 1976, prepared by Tetra Tech, Inc., under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A027 131.

WORK UNITS. . . . .

1B01 Investigation of Mathematical Models for Predicting the Physical Fate of Dredged Material. Hydraulics Laboratory (HL), WES. $28,400. Completed: final report published, TR D-74-1.

1B02 Development of Model for Prediction of Short-term Fate of Dredged Material Discharged in the Estuarine Environment. Tetra Tech, Inc. $98,310. Completed: final report published, CR D-76-5.

1B03 Koh-Chang Model on WES Computer and Survey of Disposal Sites to Determine Applicability of Model. HL, WES. $14,100. June 1974. Completed: no report.

1B04 Assessment of Factors Controlling the Long-Term Fate of Subaqueous Banks of Dredged Material. Texas A&M Research Foundation. $26,777. Completed: final report published, CR D-74-8.

1B05 Development of a Two-Dimensional Sediment Transport Model. University of California at Davis. $120,719. Completed: report in review.

1B06 Evaluation of Koh-Chang Model (Phase I) and Sensitivity Analyses. HL, WES, EPA. $20,730. Completed: report in review.

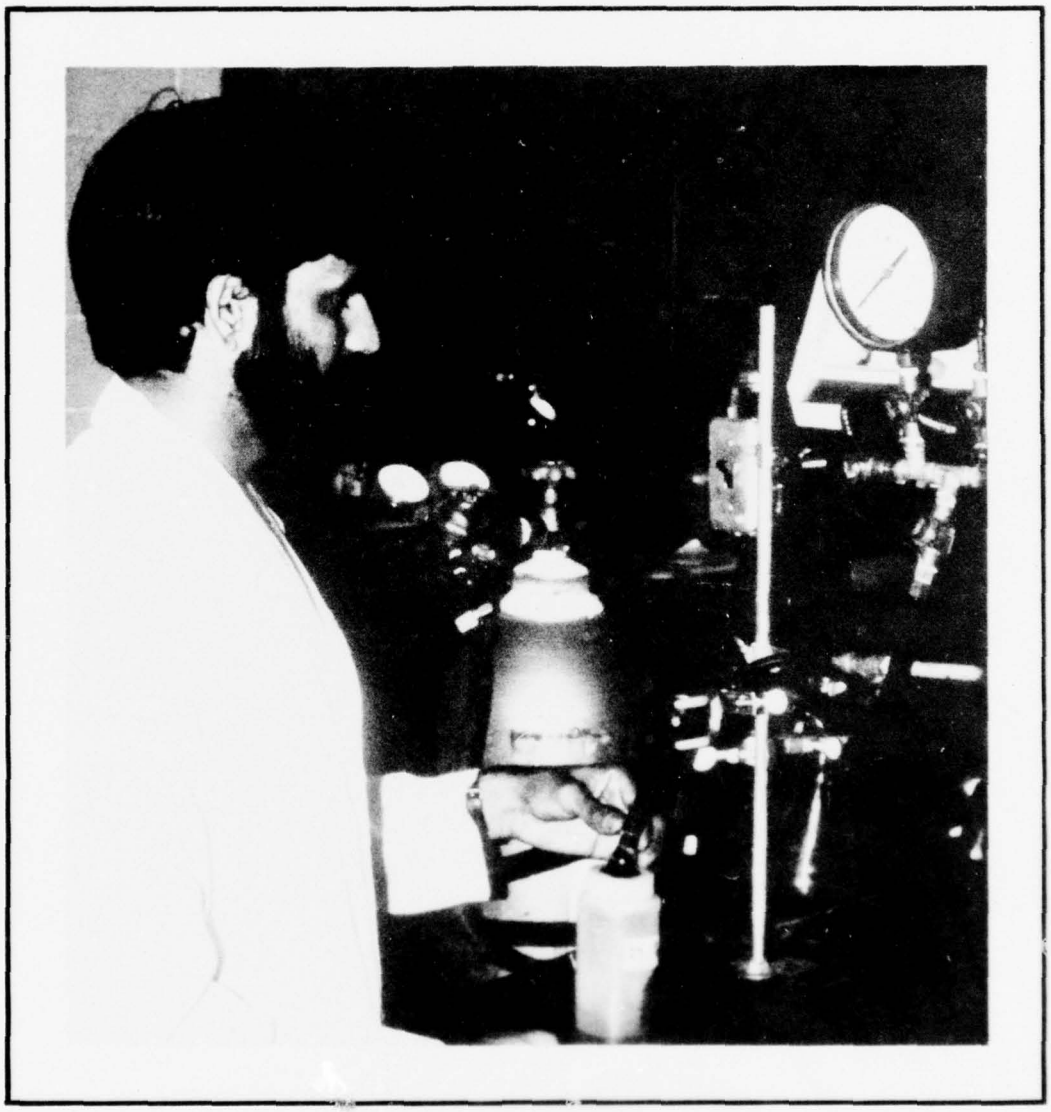
1B07 Participation in Field Verification of Koh-Chang Model and Further Sensitivity Analysis. HL, WES. $62,000. Active.

1B08 A Field Investigation of the Effects of Winter Storms on the Stability and Fate of Dredged Material in Subaqueous Disposal Areas. Yale University. $6,275. Completed: report in review.

1B09 An Investigation of the Physical Characteristics of Dredged Material and the Effects of Dispersion Behavior During Open-Water Disposal Operations. Yale University. $207,942. Active.

EFFECTS OF DREDGING AND DISPOSAL ON WATER QUALITY

(Task 1C: Environmental Impacts and Criteria Development Project)



OBJECTIVE. . . . .

— determine through laboratory investigations the short- and long-term effects on water quality due to dredging and discharging bottom sediments containing contaminants—

APPROACH. . . . .

— determine through laboratory simulations the increased or decreased mobility of nutrients, heavy metals, and chlorinated and petroleum hydrocarbons from the sediment to the water column during discharge or from the resettled sediment; evaluate those sediment geochemical and physicochemical parameters that affect contaminant mobility under a broad range of field simulations; determine through range-finding studies those critical parameters that must be investigated in multielement field studies—

STATUS. . . . .

— 5 total work units (1 in-house effort, 3 contracts, 1 interagency agreement) involving an aggregate expenditure/obligation of $419,790.

— 5 work units completed; 1 Internal Working Document prepared, 3 reports published, and 1 report in press.

— final results to be presented in 4 contract reports and 1 task synthesis report; 1 comprehensive synthesis report will include this task as well as several others.

RESULTS AND FINDINGS TO DATE. . . . .

Water Column Impacts, Descent Phase–

Constituents released to the water column from a broad range of sediments tested were ammonium, orthophosphate, manganese, iron, and suspended particulates. Ammonium was released in levels that could be considered toxic in areas of poor mixing. There was no release of other metals and nutrients, chlorinated hydrocarbons, and petroleum hydrocarbons in the dissolved state to the water column. It was found, however, that the sediments scavenged the water column of numerous constituents when fine-grained harbor sediments were dispersed in a water column. (See Contract Reports D-75-6, D-76-1, and D-76-7.)

Long-Term Release–

Inorganic constituents released from the settled sediments to the water column (with the exception of iron, manganese, and some nutrients) were in extremely small amounts (sub parts per billion) from either contaminated or non-contaminated sediments. These mobilization processes and transformations appear to occur naturally in all fine-grained sediments at similar levels and do not appear to be a significant factor in pollution. Chlorinated and petroleum hydrocarbons were not apparently released from the resettled sediments. (See Contract Reports D-75-6, D-76-1, and D-76-7.)

Controlled Environment–

Sediment/water systems were kept under physicochemical controls that simulated aquatic discharge, upland or contained disposal, and marsh (intertidal) situations. Mobilization was significantly enhanced or retarded when the physicochemical environment was changed. Maximum release was noted under acid/oxidizing conditions; however, these conditions do not normally occur in an open-water disposal or intertidal situation. They could occur in an upland contained or noncontained terrestrial site. Consequently, judicious selection of the disposal mode (open water versus upland) and an understanding of the long-term implications of either disposal mode are imperative. (See Contract Report D-76-1.)

REPORTS PUBLISHED. . . . .

CR D-75-6
(Work Unit 1C04)

Fulk, R., Gruber, D., and Wullschleger, R., "Laboratory Study of the Release of Pesticide and PCB Materials to the Water Column During Dredging and Disposal Operations," December 1975, prepared by Envirex, Inc., Milwaukee, Wisconsin, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD 026 685.

CR D-76-1
(Work Unit 1C05)

Chen, K. Y., et al., "Research Study on the Effect of Dispersion, Settling, and Resedimentation on Migration of Chemical Constituents During Open-Water Disposal of Dredged Materials," February 1976, prepared by the Environmental Engineering Program, University of Southern California, Los Angeles, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A022 144.

CR D-76-7
(Work Unit 1C03)

Blom, B. E., et al., "Effects of Sediment Organic Fractions on the Migration of Various Chemical Constituents During the Disposal of Dredged Material," May 1976, prepared by the U. S. Army Cold Regions Research and Engineering Laboratory for the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A027 394.

WORK UNITS. . . . .

1C01 Determination of Chemical Migration Control Factors. EEL, WES. $2,750. Completed: published as Internal Working Document.

1C03 Effects of Sediment Organic Fractions on the Migration of Various Chemical Constituents During the Disposal of Dredged Material. Cold Regions Research and Engineering Laboratory (CRREL). $126,000. Completed: final report published, CR D-76-1.

1C04 Laboratory Study of the Release of Pesticide and PCB Materials to the Water Column During Dredging and Disposal Operations. Envirex, Inc. $102,300. Completed: final report published, CR D-75-6.

1C05 Study of Eh, pH, and DO Effects on Chemical Constituent Migration During Open-Water Disposal of Dredged Material. Louisiana State University. $91,171. Completed: in press.

1C06 Research Study on the Effect of Dispersion, Settling, and Resedimentation on Migration of Chemical Constituents During Open-Water Disposal of Dredged Material. University of Southern California. $97,565. Completed: final report published, CR D-76-1.

EFFECTS OF DREDGING AND DISPOSAL ON AQUATIC ORGANISMS

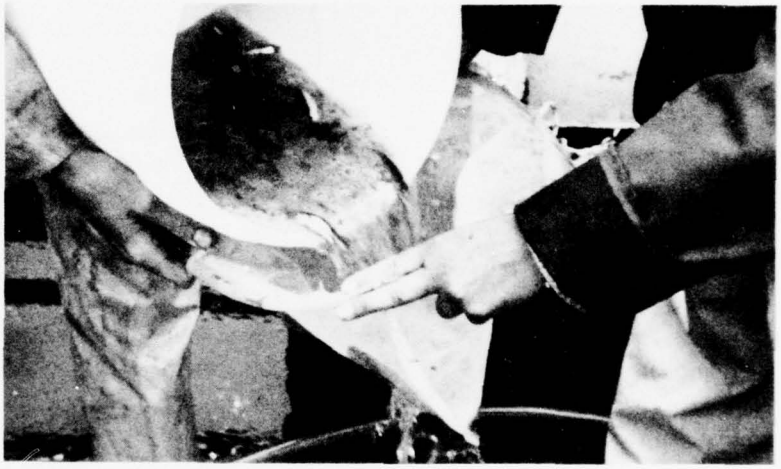
(Task 1D: Environmental Impacts and Criteria Development Project)

OBJECTIVE. . . . .

— to determine on a regional basis the direct and indirect effects on aquatic organisms due to dredging and disposal operations—

APPROACH. . . . .

— evaluate through literature synthesis, laboratory simulation, and field investigations the physical and chemical impacts of dredged material on the water column and benthic organisms—



STATUS. . . . .

— 11 total work units (2 in-house efforts, 8 contracts, 1 interagency) involving an aggregate expenditure/obligation of $1,103,528.

— 2 work units completed and 9 work units active; 2 reports published and 6 reports in review or preparation.

— final results to be presented in 10 additional reports and 1 synthesis document; 1 comprehensive synthesis report will include this task as well as others.

RESULTS AND FINDINGS TO DATE. . . . .

Physical Impacts–

Turbidity studies using marine, estuarine, and freshwater organisms have shown lethal concentrations of suspended dredged material to be significantly higher (an order of magnitude or more) than concentrations observed in actual dredging and discharge activities. Vertical migration investigations of selected organisms (clams, crabs, and benthic worms) have shown them to recover through as much as a metre of like material (i.e., sand on sand, mud on mud) or have been smothered by as little as a few centimetres covering of unlike material (i.e., sand on mud or mud on sand). Judicious selection of a disposal site to avoid substrate changes is imperative to minimize immediate or long-term physical impacts. (See Work Units 1D03, 1D09, and 1D10.)

Chemical Impacts–

Chemical constituent uptake studies involved crustaceans, bivalves, and benthic worms exposed and grown in highly contaminated sediments. Little or no uptake of metals from the solid phase was observed. Where some uptake occurred, no clear trends were evident. There was little or no uptake of most hydrocarbons from the solid phase. In some instances there was a slight uptake of a mineral oil fraction. (See Work Units 1D06, 1D07, 1D09, and 1D11.)

Recolonization Investigations–

Field studies demonstrated benthic recolonization of dredged areas and disposal mounds to be rapid for fine-grained sediment and to require up to 3 years for coarse-grained sediments. Recovery in a mudflow (fluid mud) area from pipeline disposal was similar. (See Work Units 1D10 and 1D12.)

REPORTS PUBLISHED. . . . .

TR D-76-3
(Work Unit 1D04)

Hall, R. W., Westerdahl, H. E., and Eley, R. L., "Application of Ecosystem Modeling Methodologies to Dredged Material Research," June 1976, Environmental Effects Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A027 207.

WORK UNITS. . . . .

1D01 Assessment of Aesthetic and Ecological Significance of Turbidity in Various Aquatic Environments. Living Marine Resources, Inc. $46,329. Completed: draft report in review.

1D02 Assessment of Equipment, Methodologies and Institutional Capabilities Available for Conducting or Development Bioassays. Wapora, Inc. $49,664. Completed: final report in preparation.

1D03 Determination of the Vertical Migration Ability of Benthos in Dredged Material Deposits. University of Delaware. $127,163. Completed: draft report in review.

1D04 Application of Simulated Ecosystem Modeling to Dredged Material Research (Phase I). EEL, WES. $74,553. Completed: final report published, TR D-76-3.

1D06 Study of Availability of Sediment-Sorbed Heavy Metals to Benthos with Particular Emphasis on Deposit-Feeding Infauna. Texas A&M Research Foundation. $136,706. Active.

1D07 Study of the Availability of Sediment-Adsorbed Pesticides (DDT, Chlordane, Malathion) to Benthos with Particular Emphasis on Deposit-Feeding Infauna. LFE Environmental Analysis Labs. $106,282. Completed: final report in preparation.

1D08 Design and Establishment of Estuarine Ecosystem Simulations (Phase I). EEL, WES. $203,164. Completed: draft report in review.

1D09 Effects of Suspended Dredged Material on Aquatic Animals. Bodega Bay Marine Labs. $167,250. Active.

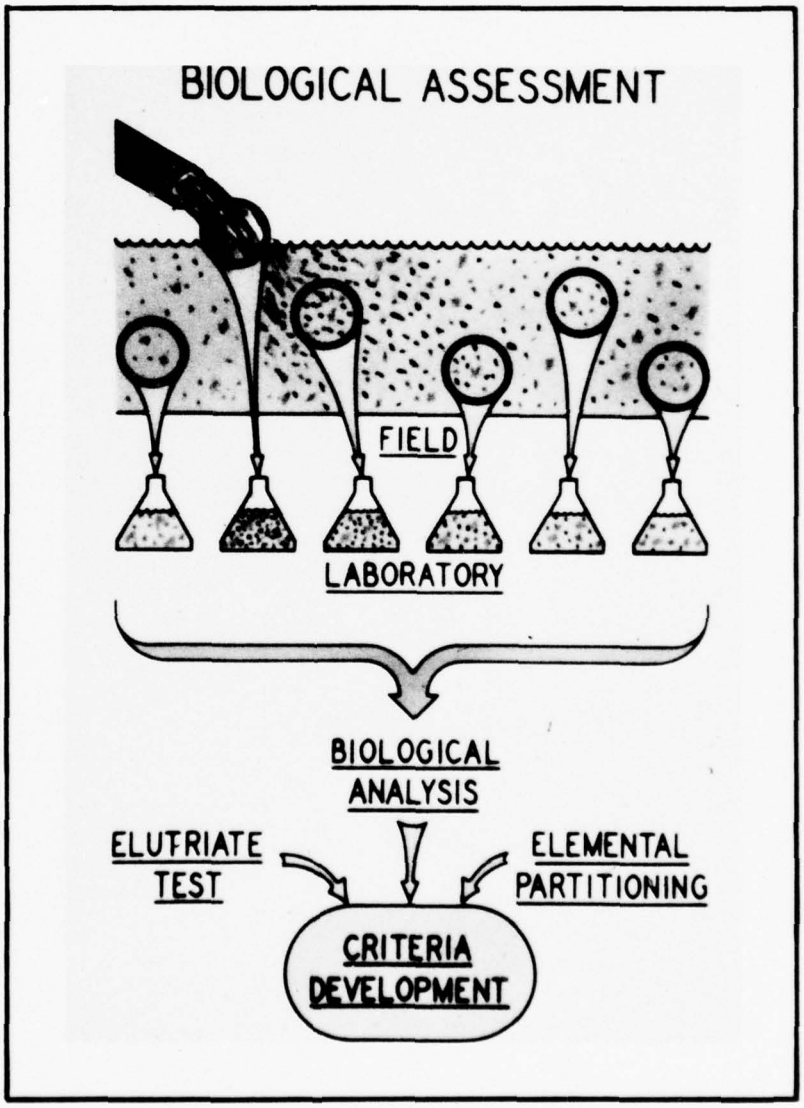
1D10 Effects of Dredging and Dredged Material Disposal on Benthos and the Marine Environment. San Jose State University. $106,662. Completed: draft report in review.

1D11 An Evaluation of Oil and Grease Contamination Associated with Dredged Material. Naval Biomedical Research Lab. $72,402. Active.

1D12 Biological Effects of Fluid Mud. VIMS. $13,353. Active.

POLLUTION STATUS OF DREDGED MATERIAL

(Task 1E: Environmental Impacts and Criteria Development Project)

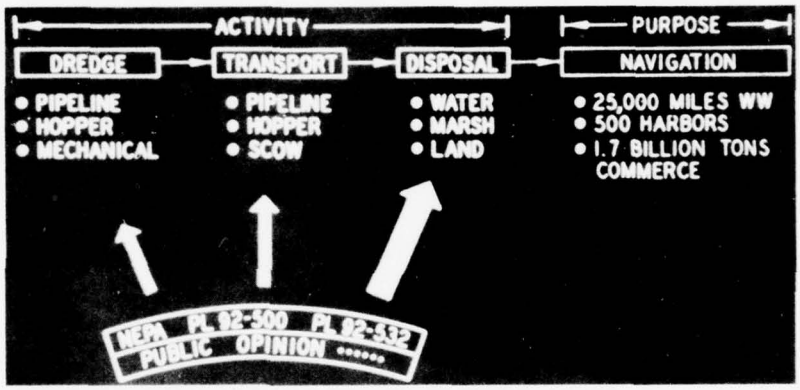


OBJECTIVE. . . . .

— to develop techniques for determining the pollutional properties of various dredged material types discharged under varying environmental conditions—

APPROACH. . . . .

— conduct high intensity, short duration laboratory investigations with subsequent field verification to develop physical, chemical, biochemical, and biological assessment techniques to implement Section 404 of PL 92-500 and Section 103 of PL 92-532; place emphasis on water column dissolved and particulate phases and long-term benthic organism effects—



STATUS. . . . .

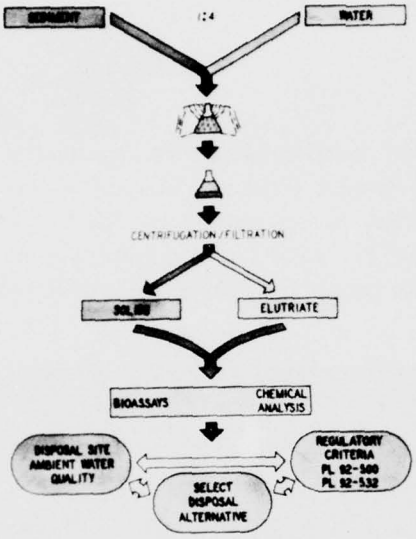
— 7 total work units (4 in-house, 3 contracts) involving an aggregate expenditure/obligation of $1,383,880.

— 3 work units completed; 2 reports published, 1 report in final preparation, 1 report in press, and 4 work units are active.

— final results to be presented in 8 contract and technical reports and 1 comprehensive synthesis report.

RESULTS AND FINDINGS TO DATE. . . . .

Water Column Impacts–



The Standard Elutriate Test adequately predicts mobilization of chemical constituents to the water column. An algal bioassay has been developed for aqueous phase testing and is available for field use. A zooplankton bioassay has been developed for evaluation of the nonfiltered elutriate and for prediction of suspended particulate effects. Field verification of these procedures has shown water column impacts to be virtually insignificant. (See Work Units 1E03, 1E03A, 1E03B, 1E04, 1E06, 1E07.)

Benthic Impacts–

Development of a benthic organism bioassay has received major emphasis for the past 12 months. The procedures under evaluation using several different trophic levels of organisms have shown promise. Development of an implementable benthic assay is scheduled for mid-1977. Field verification of benthic impacts has placed emphasis on contaminant uptake. Results of long-term benthic impacts (i.e., contaminant uptake) are being evaluated at this time. (See Work Units 1E03A, 1E03B, 1E07, 1E08.)

REPORTS PUBLISHED. . . . .

CR D-74-1 (Work Unit 1E03) — Lee, G. F., and Plumb, R. H., "Literature Review on Research Study for the Development of Dredged Material Disposal Criteria," June 1974, prepared by the Institute for Environmental Studies, University of Texas-Dallas, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD 780 755.

CR D-75-4 (Work Unit 1E03) — Lee, G. F., et al., "Research Study for the Development of Dredged Material Disposal Criteria," November 1975, prepared by the Institute of Environmental Sciences, University of Texas-Dallas, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A019 953.

WORK UNITS. . . . .

1E03 — Development of Dredged Material Disposal Criteria. University of Texas at Dallas. $133,018. Completed: literature review and final report published, CR D-74-1 and CR D-75-4.

1E03A — Refinement of Current Disposal Criteria, Identification of Subject Areas for Further Development, and Refinement of Bioassay Procedures for Disposal Criteria. University of Texas at Dallas. $143,545. Active.

1E03B — Field Testing and Verification of Dredged Material Disposal Criteria, University of Texas at Dallas. $157,995. Active.

1E04 — Investigation of the Partitioning of Various Elements in Dredged Material. EEL, WES. $312,600. Completed: final report in preparation.

1E06 — Biological Assessment of the Standard Elutriate Test. EEL, WES. $297,220. Completed: final report in press.

1E07 — Long-Term Release of Contaminants from Dredged Material. EEL, WES. $69,500. Active.

1E08 — Development of Bioassay Methodologies Using Selected Benthic Organisms. EEL, WES. $270,000. Active.

CONFINED DISPOSAL AREA EFFLUENT AND LEACHATE CONTROL

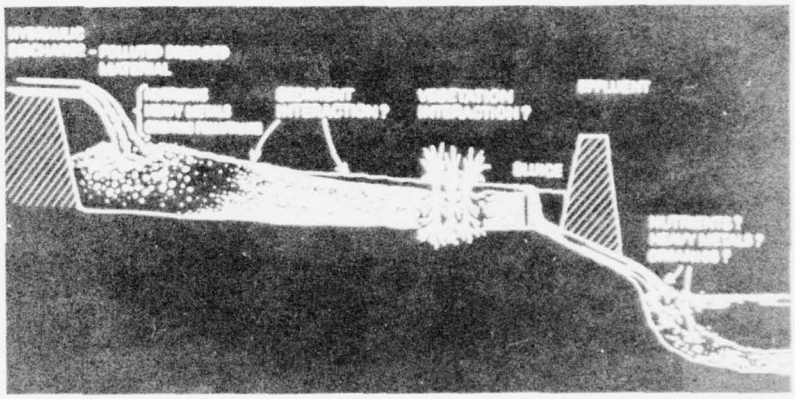
(Task 2D: Environmental Impacts and Criteria Development Project)

OBJECTIVE. . . . .

— to characterize effluents and leachates from confined land disposal facilities, determine whether changes occur in contaminant release over time, and develop methods to predict or control contamination of the surrounding environment—

APPROACH. . . . .

— determine through field and laboratory investigations, ecological problems created from surface runoff or leachate movement from confined dredged material disposal areas; investigate site-specific hydrological, geological, and physical conditions; monitor nutrients, trace metals, and chlorinated and petroleum hydrocarbons in solid and liquid phases; determine parameters and combinations of conditions that indicate short- and long-term impacts—



STATUS. . . . .

— 5 total work units (1 in-house, 3 contracts, 1 interagency) involving a total expenditure/obligation of $638,025.

— 4 work units active.

— final results to be presented in 1 in-house report, 3 contract reports, and 1 task synthesis report.

RESULTS AND FINDINGS TO DATE. . . . .

Effluent Characterization–

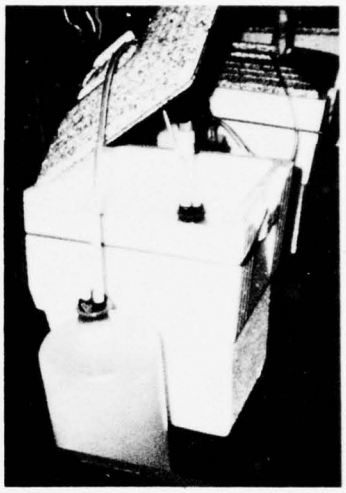
Effluents were found to differ in several physicochemical properties from ambient surface background waters. Most contaminants, especially the chlorinated hydrocarbons DDT and DDE, PCBs, oil and grease, total organic carbon, and most trace metals, are associated with the solid phase of effluents. Therefore, a decrease in effluent turbidity greatly accentuated this removal. Influent and effluent solids varied drastically with dredging and maintenance of the disposal area discharge.

Nutrients were found at high concentrations in most influents and effluents. Salinity stratification caused geochemical parameters to vary widely. Generally, the filtered background water concentration of constituents often reflects the concentrations found in effluent filtrates.

Increased turbidity, short resident time, extensive overland flow in the disposal area, or the stirring of sediment by turbulent flow at the discharge area can cause a depletion of dissolved oxygen. Long residence time and extensive ponding in large disposal areas will mitigate dissolved oxygen problems. Large quantities of petroleum residues may inhibit solids sedimentation by forming fluid mud conditions; however, deep ponded areas alleviate this problem.

Leachate Characterization–

Laboratory-produced surface-applied pulses of water are initially showing very high peak concentrations of iron, manganese, zinc, copper, lead, cadmium, and mercury with apparent equilibrium after 1 to 2 months. Leachates are affected by the interacting subsoil on which the dredged material is placed. A highly organic, high humus subsoil may induce leachates containing higher trace metal levels than the dredged material.



WORK UNITS. . . . .

2D01 Physical and Chemical Characterization of Contaminated Dredged Material Influents, Effluents, and Sediments in Confined Upland Disposal Areas. EEL, WES. $134,000. Active.

2D02 A Study of Leachate from Dredged Material in Upland Disposal Sites and/or in Productive Uses. SCS Engineers. $153,094. Active.

2D03 Physical and Chemical Monitoring of River Sediments and Water and Confined Disposal Area Dredged Material Influents, Effluents, and Sediments During High-Solids Dredging of a PCB Spill. EPA Region X, and Seattle District, CE. $17,012. Completed: data input to Work Unit 2D01.

2D04 Characterization of Confined Disposal Area Influent and Effluent Particulate and Petroleum Fractions. University of Southern California. $32,708. Active. Will be input to Work Unit 2D01.

2D05 Physical and Chemical Characterization of Dredged Material Sediments and Leachates in Confined Land Disposal Areas. University of Southern California. $159,012. Active.

EFFECTS OF MARSH AND TERRESTRIAL DISPOSAL

(Task 2A: Habitat Development Project)

OBJECTIVE. . . . .

— to identify, evaluate, and monitor the specific short-term and more general long-term effects of confined and unconfined disposal of dredged material on upland, marsh, and wetland habitats—

APPROACH. . . . .

— determine through field and laboratory evaluation the impact of direct wetland disposal and assess the potential of contaminant release from biological communities established on dredged material—

STATUS. . . . .

— 7 work units originally assigned to Task 2A and 3 reassigned from Task 4A involve an aggregate expenditure of $907,160. Five of these are in-house studies and five are contract studies.
— 3 work units completed, 1 report published.
— final results to be presented in 6 reports and 1 synthesis document.

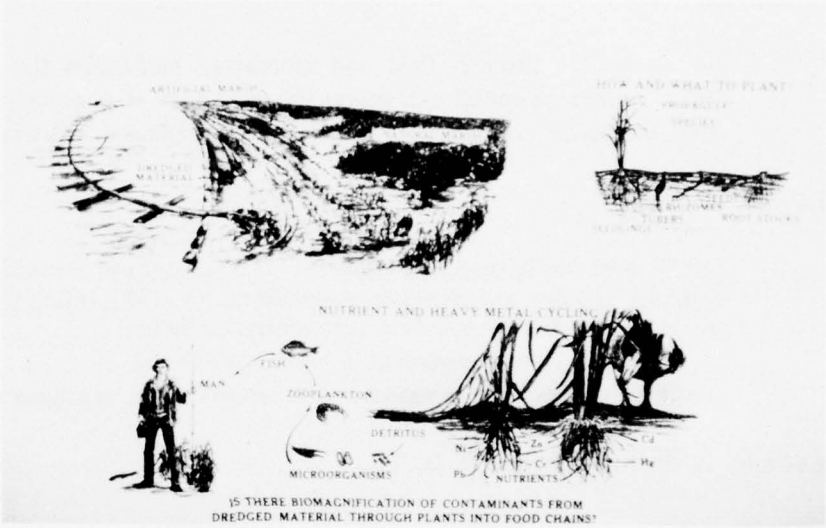
RESULTS AND FINDINGS TO DATE. . . . .

Marsh Recovery–

Preliminary data indicate that salt marshes may be able to recover from deposition of dredged material of up to 9 inches. Recovery response does not appear to be greatly influenced by the texture of the dredged material. Recovery of benthic and nektonic communities appears to parallel vegetative recovery. (See Work Unit 2A07.)

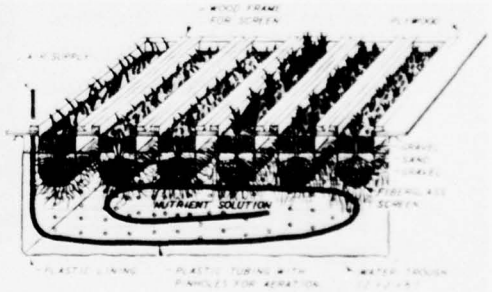
Marsh and Estuarine Model–

A conceptual model for marsh-estuarine nutrient cycling has been developed to depict inputs and potential products from these ecosystems. Nutrient and heavy metal cycles were evaluated in light of recent research and compartmentalized within each system. (See Work Unit 2A07.)



Hydroponics: Heavy Metals–

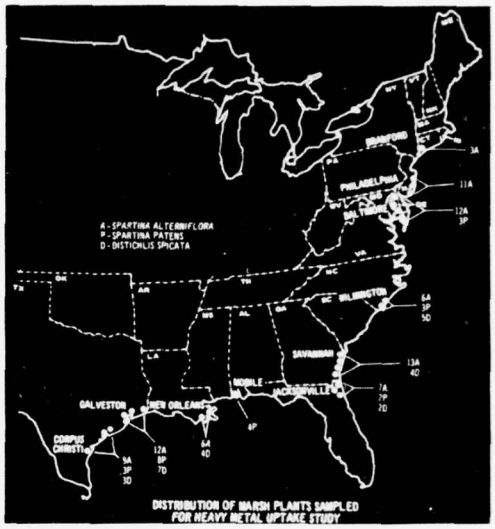
Eight marsh plants were exposed, in hydroponic solution, to heavy metals. *Cyperus esculentus, Spartina patens, Distichlis spicata,* and *Spartina alterniflora* showed significant potential for accumulating heavy metals, while *Scirpus validus, Scirpus robustus, Triglochin maritima,* and *Spartina foliosa* did not. Lead and chromium were taken into the roots of all species but were not translocated to the leaves and stems. Cadmium, zinc, and nickel were accumulated in varying amounts in the leaves and stems of several species. (See TR D-76-5.)



HYDROPONIC SYSTEM FOR
HEAVY METAL UPTAKE STUDY

Field Verification: Heavy Metals–

Marsh plants growing voluntarily on disposal sites were sampled at 29 locations along the Gulf and Atlantic coasts. Little heavy metal uptake, beyond that found in natural marshes, was noted. A methodology to predict heavy metal uptake from dredged material prior to habitat establishment is being developed. (See Work Unit 4A15B.)



DISTRIBUTION OF MARSH PLANTS SAMPLED FOR HEAVY METAL UPTAKE STUDY

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

— effects of Eh and pH on the availability of heavy metals to marsh plants. (See Work Unit 4A06.)

— long-term response of marsh plants to deposition (See Work Unit 2A07).

— a proven extraction procedure to predict heavy metal uptake prior to plant establishment on dredged material. (See Work Unit 4A15B.)

REPORT PUBLISHED. . . . .

TR D-76-5
(Work Unit 4A15)

Lee, C. R. et al., "A Hydroponic Study of Heavy Metal Uptake by Selected Marsh Plant Species," June 1976. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A033 224.

WORK UNITS. . . . .

2A01, 2B01 — Methodology for Assessing the Social, Economic, and Environmental Effects of Dredged Material Disposal on Marsh and Upland Areas. Battelle Memorial Institute, Columbus. $119,620. Completed: published as Internal Working Document.

2A02, 2B02 — Collection and Assessment of Data on Land and Coastal Disposal Sites and Selection of Initial Test Sites. Interlaboratory team, WES. $140,650. Draft report being revised.

2A07 Effect of Dredged Material Deposition on Short Form *Spartina alterniflora* Marsh. University of Georgia, Marine Resources Extension Center. $87,839. Active.

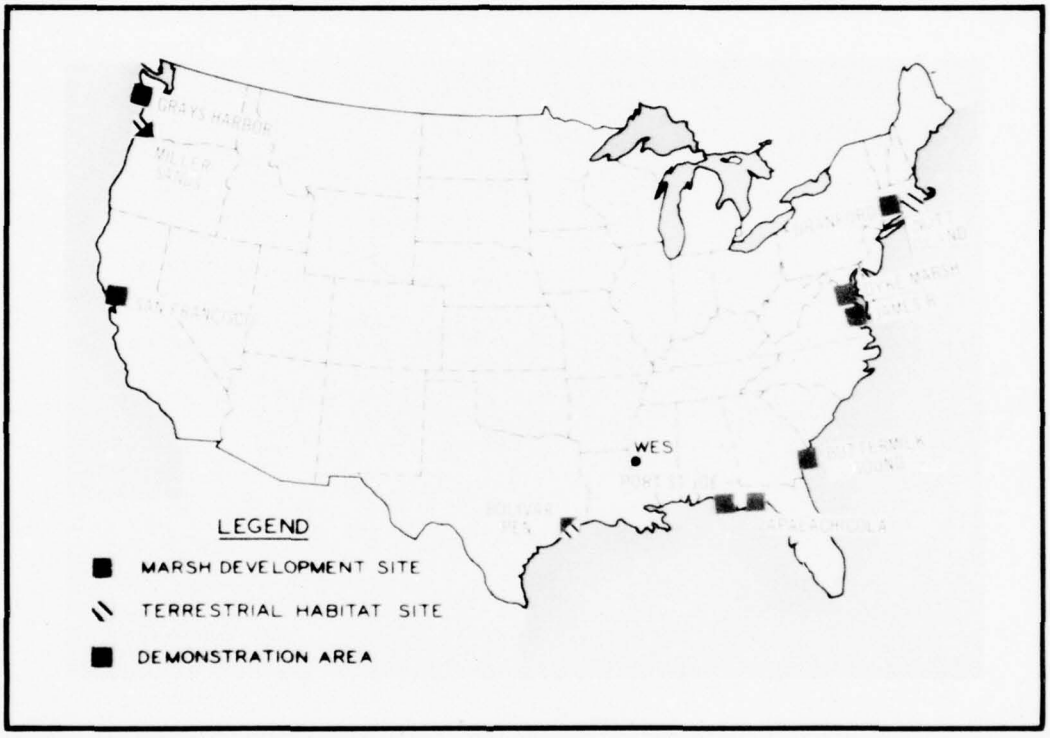
4A15A Heavy Metal Uptake by Marsh Grasses (Phase I). EEL, WES. $87,000. Completed: final report published, TR D-76-5.

4A15B Heavy Metal Uptake by Marsh Grasses (Phase II). EEL, WES. $144,178. Active.

4A06 Physiological Response of Marsh Plants to Environmental Stress. (In Part). Louisiana State University. $96,712. Draft report being reviewed.

MARSH DEVELOPMENT

(Task 4A: Habitat Development Project)



OBJECTIVE. . . . .

— to develop, test, and evaluate the environmental, economic, and engineering feasibility of using dredged material as a substrate for marsh development—

APPROACH. . . . .

— conduct field studies at selected sites to test the problems and techniques of marsh development under various substrate, salinity, tidal, and climatic conditions; evaluate, under laboratory and field conditions, the productivity of both major and minor marsh plant species, their substrate selective properties, and their patterns of ecological succession—

STATUS. . . . .

— 48 work units (5 in-house efforts, 31 contracts, 12 interagency agreements), involving an aggregate expenditure of $3,505,946.
— 32 work units completed: 7 Internal Working Documents prepared, 21 provided baseline data for subsequent field studies, and 4 reports published.
— final results will be presented in 26 reports, including 3 synthesis reports and 5 field site reports with a total of 11 appendixes.

RESULTS AND FINDINGS TO DATE. . . . .

Field Sites–

Marsh habitat has been successfully established at dredged material disposal sites in Virginia, Georgia, Florida, Texas, California, and Oregon. Two of these sites (Texas and Oregon) include upland habitat development studies and these aspects are discussed under Task 4B. Items under consideration in Task 4A include site selection, stabilization of the newly placed substrate, species selection, planting techniques, fertilization requirements, marsh productivity and succession, wildlife use, contaminant mobility, and an assessment of the environmental impact of marsh development.

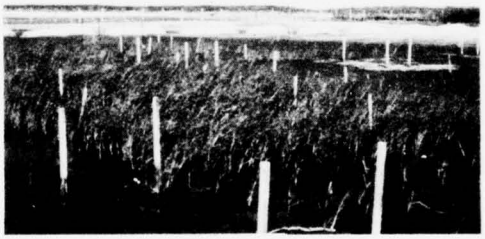
WINDMILL POINT. A 20-acre freshwater marsh island complex was established at Windmill Point in the James River, Virginia, using fine-textured contaminated dredged material. Natural invasion by arrow arum, pickerel weed, and arrowhead quickly established a lush, highly productive marsh. The major thrust of the research at Windmill Point is evaluation of contaminant uptake and release by plants growing on contaminated dredged material and determination of plant and animal productivity and succession. Study results will address the impact and feasibility of freshwater marsh development on fine-textured dredged material. (See Work Unit 4A11.)

DYKE MARSH. Detailed design has been completed for restoration of portions of Dyke Marsh on the Potomac River near Alexandria, Virginia. Natural marsh in this area was largely destroyed by sand and gravel mining operations. Initiation and construction at this site is contingent upon final approval of the National Park Service and support from local environmental organizations. (See Work Unit 4A17.)

BUTTERMILK SOUND. A 3-acre brackish water marsh has been established on dredged material along the Intracoastal Waterway in Buttermilk Sound, Georgia. The purpose of this study is to determine the productivity and success of establishment, by both seeding and sprigging, of eight marsh species at three tidal elevations under five

fertilizer regimes. Information derived from this study will be valuable in the selection of species and propagative techniques for salt marsh establishment in the southeastern United States. (See Work Unit 4A12.)

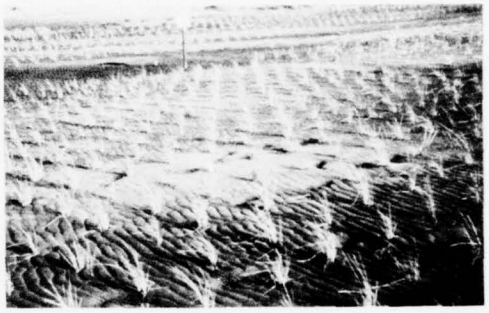
APALACHICOLA BAY. A small marsh development project to test the efficacy of planting *Spartina alterniflora* and *Spartina patens* on poorly consolidated fine-grained marine sediments has been undertaken near Apalachicola, Florida. Elevational and productivity relationships are being evaluated as well as operational constraints encountered in the use of mechanical equipment on poorly consolidated dredged material. (See Work Unit 4A19.)



BOLIVAR PENINSULA. A 9-acre salt marsh has been established on sandy dredged material on the Bolivar Peninsula near Galveston, Texas. The objectives of this study are to develop propagative techniques for salt marsh establishment along the Gulf Coast and to test the effectiveness of a sandbag dike placed to reduce high wave energies in this area. Benthic and nektonic colonization of the site, the response of salt marsh to an intertidal elevational gradient, and various rates of fertilization are also being evaluated in this project. (See Work Unit 4A13.)

POND #3. Common Pacific coast marsh species have been planted on a 10-acre disposal site in San Francisco Bay. Research at this site is directed toward an evaluation of salt marsh productivity on fine-grained dredged material, determining the most desirable

planting season, testing various sprigging and seeding techniques, and determining the most efficient spacing distances for marsh creation. (See Work Unit 4A18.)



MILLER SANDS. A 9-acre intertidal portion of a sandy dredged material disposal site in the Columbia River near Astoria, Oregon, was planted with 6 species of freshwater marsh plants. The purpose of this research is the selection of appropriate freshwater plants for marsh establishment in the Pacific Northwest, the testing of marsh establishment techniques, and an assessment of the environmental impacts of marsh development. Plant survival and productivity, wildlife usage, and benthic and nektonic colonization are also being studied. (See Work Unit 4B05.)

Ecological Succession–

Extensive evaluation of the ecological successional patterns of *Spartina alterniflora, S. patens,* and *Distichlis spicata* indicate that radiation, temperature, tidal inundation, elevation, and salinity are the critical factors in determining productivity and natural succession. A computer model, designed to predict the productivity of a salt marsh given these critical factors, has been developed and can be used in the design of man-made marshes. (See Work Unit 4A05.)

Prediction of Stable Elevation–

A technique has been developed for predicting the final stable elevation of dredged material placed in a confined intertidal disposal area. The method, not yet field tested, predicts the volume of material actually retained within the containment area as related to the volume of channel material removed. (See Work Unit 4A16.)

Marsh Productivity–

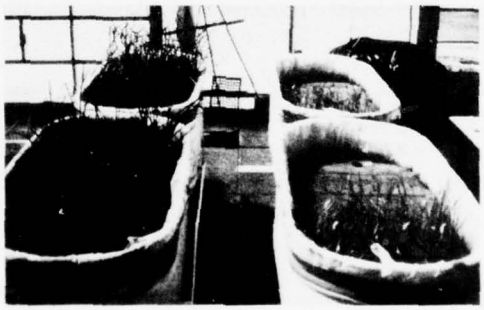
Major and minor grass species have been evaluated to quantify their productivity under a variety of environmental conditions including substrate

type, intertidal elevation, salinity range, and geographic location. *Spartina alterniflora, S. patens*, and *Distichlis spicata* appear to be the most promising salt marsh species for establishment on dredged material along the Atlantic and Gulf coast. (See Work Units 4A04A-B, 4A06.)

Guidelines for Dredged Material Placement–

A systematic set of guidelines for creating new marshes from dredged material under a variety of situations and constraints have been developed. Engineering and operational practices and problems were considered in the development of these guidelines. The most critical factors in marsh development were determined to be the elevation, protection, and confinement of the dredged material. (See Contract Report D-75-2.)

Establishment Techniques–



Factors affecting plant establishment in saltwater and freshwater marshes have been examined under controlled greenhouse conditions. Propagation techniques, propagule types, tidal regimes, and substrate types were studied. In general, propagation by sprigs was more successful than propagation by seeds, tubers, or rhizomes. Fine-grained dredged material was usually more productive than coarse-grained material as the former contained more available nutrients. Salinity was indicated as a possible limiting factor in establishing brackish marsh plants. The data obtained will be carefully compared with similar information obtained under field conditions. (See Work Unit 4B06.)

Identification of Criteria for Marsh Development and Potential Application Sites–

Biophysical and socioeconomic data and rationale needed to evaluate potential marsh development sites have been examined and tested at 50 project areas throughout the United States. This study indicated that careful application of design techniques provides considerable flexibility in the marsh development alternative. (See Contract Report D-76-2.)

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Final determinations of the environmental, engineering, and economic impacts of marsh development at the habitat development field sites. (See Work Units 4A11, 4A12, 4A13, 4A17, 4A18, 4A19, 4B05.)

REPORTS PUBLISHED. . . . .

CR D-74-9
(Work Unit 4A03)

Kadlec, J. A., Wentz, W. A., Jr., and Smith, R. L., "State-of-the-Art Survey and Evaluation of Marsh Plant Establishment Techniques: Induced and Natural (Volumes I and II)," December 1974, prepared by the School of Natural Resources, The University of Michigan-Ann Arbor, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A012 837.

CR D-75-2
(Work Unit 4A08)

Johnson, L. E., and McGuinness, W. V., Jr., "Guidelines for Material Placement in Marsh Creation," April 1975, prepared by the Center for Environment and Man, Inc., under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD 010 725.

CR D-76-2
(Work Unit 4A01)

Coastal Zone Resources Corporation, "Identification of Relevant Criteria and Survey of Potential Application Sites for Artificial Habitat Creation (Volumes I and II)," October 1976, prepared under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD 010 725.

TR D-76-6
(Work Unit 4A17)

Palermo, M. R., and Zeigler, T. W., "Feasibility Study for Dyke Marsh Demonstration Area, Potomac River, Virginia," November 1976, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A033 524.

WORK UNITS. . . . .

4A01	Study of Identification of Relevant Criteria and Survey of Potential Application Sites for Artificial Habitat Creation. Coastal Zone Resources Corporation. $86,438. Completed: final report published, CR D-76-2.
4A03	State-of-the-Art Survey and Evaluation of Marsh Plant Establishment Techniques. University of Michigan. $24,967. Completed: final report published, CR D-74-9.
4A04A	Productivity of Minor Marsh Grass Species and Their Substrate Selective Properties (Atlantic Coast Area) University of Georgia Marine Institute. $211,559. Active.
4A04B	Productivity of Minor Marsh Grass Species (Gulf Coast Area). Dept. of Marine Sciences, Louisiana State University. $24,370. Draft report being reviewed.
4A05	Modeling of Ecological Succession and Production in Estuarine Marshes. Dept. of Environmental Sciences, University of Virginia. $188,646. Draft report being reviewed.
4A06	Physiological Response of Marsh Plants to Environmental Stress. (In Part). Louisiana State University. $142,195. Draft report being reviewed.
4A07	Concept Development and Economic and Environmental Compatibility Analyses of Underwater and/or Floating Dredged Material Retaining and Protective Structures. EEL, WES. $51,159. Draft report to be revised.
4A08	Development of Guidelines for Material Placement in Marsh Creation. Center for the Environment and Man, Inc. $62,884. Completed: final report published, CR D-75-2.
4A09	Design and Establish Salt Marsh Ecosystem Simulation (Phase I). EEL, WES. $253,100. Draft report being revised; no formal report planned.

4A10 Branford Harbor Marsh Habitat Development Site, Connecticut.

4A10A Methods for Material Confinement at Branford Harbor. Massachusetts Institute of Technology. $2,350. Completed: no formal report planned.

4A10B Technical Assistance for Branford Harbor Systems. Massachusetts Institute of Technology. $9,625. Completed: published as an Internal Working Document.

4A10C Assessment of Preoperational Environmental Conditions at the Branford Harbor. Marine Sciences Institute, University of Connecticut. $170,700. Completed: no formal report planned.

4A10D Marsh Grass Seed Collection, Storage, and Testing. Environmental Concern, Inc. $4,200. Completed: published as an Internal Working Document.

4A10F Documentation of Social Factors Affecting the Branford Harbor Project: A Plan of Study. Ms. Sue Richardson. $2,200. Completed: no formal report planned.

4A10G Documentation of Social Factors at the Branford Harbor Site. Ms. Sue Richardson. $3,619. Completed: no formal report planned.

4A10H Documentation of Political Factors at the Branford Harbor Site. Dr. F. Grupp. $3,986. Completed: no formal report planned.

4A11 Windmill Point Marsh Habitat Development Site, James River, Virginia.

4A11A Soils Exploration and Testing, Windmill Point. Soil and Material Engineers, Inc. $30,331. Completed: no formal report planned.

4A11B Dike Design, Windmill Point, Dr. Robert Y. K. Cheng, Old Dominion University. $4,820. Completed: published as an Internal Working Document.

4A11C Preoperational Assessment, Windmill Point. Virginia Institute of Marine Sciences. $10,725. Completed: published as an Internal Working Document.

4A11D Preoperational Assessment, Windmill Point. Old Dominion University. $9,805. Completed: published as an Internal Working Document.

4A11E Exploration for Sand to be Used for Dike Construction at Windmill Point. Soil and Material Engineers. $13,000. Completed: no formal report planned.

4A11F Technical and Administrative Support by Norfolk District for the Windmill Point Project. Norfolk District, CE. $55,000. Completed: published as an Internal Working Document.

4A11G Sediment and Water Chemistry Investigation at Windmill Point. Old Dominion University. $80,209. Draft report being reviewed.

4A11H Pollutant Mobilization Studies at Windmill Point. Old Dominion University. $99,575. Active.

4A11I Ecological Studies at Windmill Point. Virginia Institute of Marine Science. $210,600. Active.

4A11J Propagation of Vascular Plants at Windmill Point. Environmental Concern, Inc. $49,556. Completed: published as an Internal Working Document.

4A11K Assessment of Acute Impacts on the Macrobenthic Community at Windmill Point. Virginia Institute of Marine Science. $31,939. Draft report being reviewed.

4A12 Buttermilk Sound, Marsh Habitat Development Site, Georgia.

4A12A Study of the Biological, Chemical, and Physical Changes Associated with Marsh Establishment on a Sandy Dredged Material in Buttermilk Sound. University of Georgia. $251,200. Active.

4A12B Site Preparation, Propagule Collection, and Initial Steps in Planting Buttermilk Sound. University of Georgia. $8,262. Completed: no formal report planned.

4A13 Bolivar Peninsula, Upland and Marsh Habitat Development Site, Galveston Bay, Texas.

4A13A Topographic Survey of Bolivar Peninsula. Galveston District, CE. $7,000. Completed: no formal report planned.

4A13B Development of Soil Sampling and Testing Plans for Bolivar Peninsula. Galveston District, CE. $22,000. Completed: no formal report planned.

4A13C Inventory and Assessment of Hydrology and Water Chemistry at the Bolivar Peninsula Site. U. S. Geological Survey. $28,380. Completed: no formal report planned.

4A13D Inventory and Assessment of the Aquatic Biota at Bolivar Peninsula. National Marine Fisheries Service. $62,656. Completed: no formal report planned.

4A13E Inventory and Assessment of the Terrestrial Flora, Fauna, and Sediment Chemistry at Bolivar Peninsula. Texas A&M University. $51,823. Completed: no formal report planned.

4A13F Propagation of Vascular Plants and Post-Propagation Monitoring of the Botanical, Soils, Aquatic Biota, and Wildlife Resources, Bolivar Peninsula. Dept. of Range Science, Texas A&M University. $365,901. Active.

4A13G Plans and Specifications for Site Construction, Bolivar Peninsula. Galveston District, CE. $16,000. Completed: no formal report planned.

4A13H Sampling and Testing of Sediments, Bolivar Peninsula. Galveston District, CE. $6,000. Completed: no formal report planned.

4A13I-4A13J Construction, Maintenance, and Repair of Site, Bolivar Peninsula. Galveston District, CE. $243,000. Active.

4A14 Rennie Island Marsh Habitat Development Site, Grays Harbor, Washington.

4A14A Preliminary Survey, Rennie Island. Seattle District, CE. $2,300. Completed: no formal report planned.

4A14B Preparation of Work Statements for Rennie Island. Coastal Ecosystems Management. $1,243. Completed: no formal report planned.

4A14C Baseline Study and Literature Review. Fisheries Research Institute, University of Washington. $18,412. Completed: no formal report planned.

4A16 Prediction of a Stable Elevation for Marshes Created from Dredged Material. Massachusetts Institute of Technology. $99,000. Final report being reviewed.

4A17 Dyke Marsh Demonstration Area, Feasibility Study. EEL, WES. $30,000. Completed: final report published, TR D-76-6.

4A17A Detailed Design - Dyke Marsh Demonstration Area, Virginia. EEL, WES. $96,000. Active.

4A18 Pond #3 Marsh Habitat Demonstration Area, San Francisco, California. San Francisco District, CE. $50,350. Active.

4A18A Monitoring, Pond #3 Marsh Demonstration Area. San Francisco, California. San Francisco Bay Marine Research Center. $33,000. Active.

4A19 Apalachicola Marsh Habitat Demonstration Area, Apalachicola, Florida, Mobile District, CE. $8,490. Active.

4A20 Productivity of Marsh Plants, Pacific Coast. Dr. R. W. Rountree. $11,800. Active.

4B06 Establishment of Marsh Grasses in Dredged Material. EEL, WES. $255,571. Completed: final report in press.

TERRESTRIAL HABITAT DEVELOPMENT

(Task 4B: Habitat Development Project)

OBJECTIVE. . . . .

— to develop and apply habitat management methodologies to upland disposal areas for purposes of habitat creation, reclamation, and mitigation—

APPROACH. . . . .

— document natural plant successional patterns at terrestrial disposal areas, establish field sites to demonstrate the concept of reclamation of dredged material for upland habitat development, test plant species that both attract wildlife and thrive in disposal areas—

STATUS. . . . .

— 23 work units (2 in-house efforts, 17 contracts, 4 interagency agreements) involving an aggregate expenditure of $1,029,190.
— 17 work units completed or in final review; 6 will be Internal Working Documents, 5 deal with preoperational baseline conditions and will appear as appendixes to appropriate field site reports.
— final results will be presented in 21 reports, including 6 contract reports, 1 synthesis report, and 2 field site reports with 12 appendixes.

RESULTS AND FINDINGS TO DATE. . . . .

Field Sites–

Terrestrial habitat has been successfully established at upland dredged material disposal sites in Connecticut, Texas, and Oregon. Various propagative techniques such as fertilization, selection of drought-tolerant species, and animal control have been applied at these sites. Two of these sites (Texas and Oregon) include marsh development and those aspects are discussed under Task 4A. (See page 75.)

NOTT ISLAND. Nott Island in the Connecticut River, Connecticut, is the location of the reclamation for wildlife purposes of an 8-acre disposal site. About 23,000 cu yd of sandy material from the navigation channel of the river was disposed at this site. To

improve agronomic characteristics, the area was top dressed with 11,500 cu yd of fine-grained material and the two substrates were subsequently mixed. The area was limed and fertilized and planted with a mixture of grasses and legumes which will provide feeding habitat for Canada geese. (See Work Unit 4B04.)

BOLIVAR PENINSULA. Reclamation of a droughty upland disposal site was incorporated into marsh studies on the Bolivar Peninsula near Galveston, Texas. Research is centered around evaluation of the success of several desirable wildlife plant species under a series of fertilizer regimes. The objective of this research is the identification of trees, shrubs, and grasses that are adaptable to this and similar sites along the Gulf Coast. (See Work Unit 4A13.)

MILLER SANDS. A 50-acre habitat site has been established as a part of a marsh and terrestrial development project at Miller Sands Island in the Columbia River. Fertilization of the site and the introduction of five desirable wildlife food plants were designed to improve this once-barren disposal island to be attractive to nesting waterfowl. (See Work Unit 4B05.)

Disposal Area Filling–

Techniques for disposal area filling have been developed that are compatible with wildlife management practices. Included are items such as cellular filling of confined disposal sites to reduce the frequency of habitat disruption, and arresting succession at a given stage of development to encourage a specific species or mix of species. (See Work Unit 5B04.)

Weed Control–

Techniques have been developed for controlling the common reed, *Phragmites communis,* an undesirable invader on upland disposal sites. Both mechanical and chemical methods have proved successful in eliminating this plant. (See Work Unit 4B07.)

Upland Succession–

Upland successional patterns at disposal sites have been identified for each major climatic region of the United States. These data will prove valuable in the management of these areas as productive biological habitats. (See Work Unit 5B03.)

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Quantification of impact of habitat development on local wildlife populations. (See Work Units 4B04, 4B05, 4A13.)

Identification of desirable wildlife species appropriate for management on upland disposal sites. (See Work Unit 4B08.)

Evaluation of propagation techniques including soil amendments, plant selection, and planting methodologies. (See Work Units 4B04, 4B05, 4A13.)

WORK UNITS. . . . .

4B01	Identification and Assessment of Modes, Needs, Benefits, and Constraints of Habitat Enhancement. Hittman Associates. $83,854. Completed: no report planned.
4B04	Nott Island Upland Habitat Development Site, Connecticut River, Connecticut.

4B04A Preoperational Data Collection and Monitoring of Dredged Material Disposal, Nott Island. Marine Sciences Institute. University of Connecticut. $25,135. Completed: to be an Internal Working Document.

4B04B Technical Liaison, Nott Island. Connecticut Department of Environmental Protection. $1,900. Completed: to be an Internal Working Document.

4B04C Growth of Selected Plant Species on Dredged Material. Cooperative Extension Service, University of Connecticut. $75. Complete: no report planned.

4B04D Plot Establishment and Preoperational Data Collection (Experimental Control of *Phragmites communis*). Connecticut College. $3,000. Completed: to be an Internal Working Document.

4B04E Monitoring of Dredged Material Disposal and Reclamation, Nott Island. Connecticut College. $34,367. Active.

4B05 Miller Sands Upland and Marsh Habitat Development Site, Columbia River, Oregon.

4B05A Subsurface Exploration, Miller Sands. Portland District, CE. $6,000. Completed: no formal report planned.

4B05B Preparation of Work Statements, Miller Sands. Coastal Ecosystems Management. $1,243. Completed: no formal report planned.

4B05C Baseline Biological Inventory and Assessment of the Aquatic Environs of Miller Sands. National Marine Fisheries Service. $38,500. Completed: combined with Work Unit 4B05L.

4B05D Inventory and Assessment of Existing Environmental Conditions at Miller Sands - Terrestrial Fauna and Flora. Woodward-Clyde Consultants. $38,926. Completed: to be an Internal Working Document.

4B05E Inventory and Assessment of Existing Environmental Conditions at Miller Sands - Physical and Chemical. Oregon State University. $52,689. Completed: to be an Internal Working Document.

4B05F Pilot Study of Propagation of Marsh Plants at Miller Sands. Wave Beach Grass Nursery. $9,817. Completed: to be an Internal Working Document.

4B05G Propagation of Vascular Plants. Wave Beach Grass Nursery. $79,683. Active.

4B05H Trapping of Nutria at Miller Sands. Jack Rogers. $34,160. Active.

4B05I Postpropagation Monitoring of Wildlife Resources at Miller Sands. Oregon State University. $39,855. Active.

4B05J Aquatic Biology Investigations at Miller Sands. National Marine Fisheries Service. $80,000. Active.

4B05K Postpropagation Monitoring of Botanical and Soil Resources at Miller Sands. Washington State University. $160,559. Active.

4B05L Postoperational Aquatic Biology at Miller Sands. National Marine Fisheries Service. $46,072. Active.

4B07 The Biology and Control of the Common Reed *Phragmites communis*. Louisiana Technological Institute. $1,750. Draft report being reviewed.

5B01 Regional Identification of Species Affected by Dredging/Disposal Operations. MESL, WES. $43,700. Completed: no formal report planned.

5B02 Assessment of Species Habitat Requirements and Responses of Populations to Habitat Conditions. MESL, WES. $59,000. Completed: no formal report planned.

5B03 Study of Successional Patterns of Plants and Animals at Upland Disposal Areas. Coastal Zone Resources Corporation. $101,887. Draft report being reviewed.

5B04 Review and Examination of Disposal Area Filling Techniques and Rates to Identify Nonconflicting Wildlife Enhancement Alternatives. Dames and Moore. $87,014. Completed: no formal report planned.

AQUATIC HABITAT DEVELOPMENT

(Task 4E: Habitat Development Project

OBJECTIVE. . . . .

— to evaluate and test the feasibility of using dredged material as a substrate for aquatic habitat development and determine the impact of disposal of dredged material on aquatic habitats—

APPROACH. . . . .

— limited literature surveys and field studies on seagrass propagation and the impact of disposal on seagrass meadows—

STATUS. . . . .

— 2 ongoing work units have been contracted involving an aggregate expenditure of $33,780.
— final results will be presented in 2 reports.

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Literature Survey of Seagrasses–

Pertinent literature on 5 seagrasses (*Thalassia testudinum, Zostera marina, Halodule spp., Syringodium filiforme, Ruppia maritima*) is being compiled. Several key environmental factors controlling seagrass development and success are being evaluated: substrate, water quality, water depth, productivity, colonization, energy regimes, propagation, and tolerance to disturbance. (See Work Unit 4E01.)

Grassbed Development–

Shoalgrass (*Halodule beaudetti*) has been transplanted from a natural grassbed to a dredged material deposit near Port St. Joe, Florida. Plugs were placed in trays filled with seawater, carried to the site, then transplanted by hand to the dredged material. Site monitoring shows 90-95 percent survival, with growth and spreading of plugs apparent in less than 6 months. (See Work Unit 4E02.)

WORK UNITS. . . . .

4E01 Literature Survey of Seagrasses. University of Virginia. $28,963. Active.

4E02 Grassbed Development, St. Joseph Bay, Florida. Dr. R. C. Phillips. $4,815. Active.

Shoalgrass (*Halodule beaudetti*) transplants were obtained at a natural seagrass bed near Port St. Joe, Florida, placed in water-filled containers, and immediately transported to and planted at a nearby dredged material disposal site.

Seagrass transplanting operation on dredged material near Port St. Joe, Florida. In the absence of mechanized techniques, seagrass transplantation is now a labor-intensive effort.

ISLAND HABITAT DEVELOPMENT

(Task 4F: Habitat Development Project)

OBJECTIVE. . . . .

— investigate, evaluate, and test methodologies for habitat creation and management on dredged material islands—

APPROACH. . . . .

— document vegetative succession on dredged material islands and determine the use of those islands by wildlife in seven representative coastal and riverine areas of the United States—

STATUS. . . . .

— 5 ongoing work units have been contracted involving an aggregate expenditure/obligation of $378,710. Two additional work units will be initiated in the spring of 1977.
— final results to be presented in 7 reports and 1 synthesis report.

RESULTS AND FINDINGS TO DATE. . . . .

Great Lakes Colonial Birds–

In 1976, an estimated 335,000 adult colonial nesting birds utilized 205 sites in the American Great Lakes. At least 35 of these are dredged material disposal sites. Several of these man-made islands are located in densely populated areas. (See Work Unit 4F01A.)

Bird Island, formed in 1963 by dredged material disposal, is heavily used by colonial bird species in Tampa Bay, Florida.

An extremely dense, lush growth of *Phragmites communis, Spartina sp.*, and other grasses characterize this diked disposal island in the Cape Fear River in North Carolina. It is being used for nesting by numerous ringbilled gulls.

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Determination of wildlife use of and vegetational succession on dredged material islands in 5 regions. (See Work Units 4F01A-D, 4F02.)

Determination of the impact of diking on vegetation succession and animal use of dredged material islands. (See Work Unit 4F02.)

WORK UNITS. . . . .

4F01A Survey of Critical Nesting and Migration Areas of the Great Lakes and Comparisons of Dredged Material and Natural Island Breeding Habitats. Northwest Michigan College. $58,000. Active.

4F01B Use of Dredged Material Island by Colonial Seabirds and Wading Birds in Texas. Texas A&I University. $84,383. Active.

4F01C Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in Florida. Seabird Research, Inc. $53,885. Active.

4F01D Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in New Jersey. Manomet Bird Observatory. $87,724. Active.

4F02 A Comparison of Plant Succession and Bird Utilization on Diked and Undiked Dredged Material Islands in the North Carolina Estuaries. University of North Carolina. $94,721. Active.

CONTAINMENT AREA OPERATIONS

(Task 2C: Disposal Operations Project)

OBJECTIVE. . . . .

— to develop new or improved methods for the operation and management of confined disposal areas and associated facilities—

APPROACH. . . . .

— to develop and test concepts to facilitate area operations, prepare guidelines for area design and construction, demonstrate management practices to enhance area effectiveness and environmental compatibility—

STATUS. . . . .

— 18 total work units (7 in-house efforts, 10 contracts, 1 interagency agreement) involving an aggregate expenditure/obligation of $1,042,700.
— 9 work units completed; 7 reports published.
— final results to be presented in 7 additional reports and 2 synthesis documents; 2 special purpose information transfer documents in preparation.

RESULTS AND FINDINGS TO DATE. . . . .

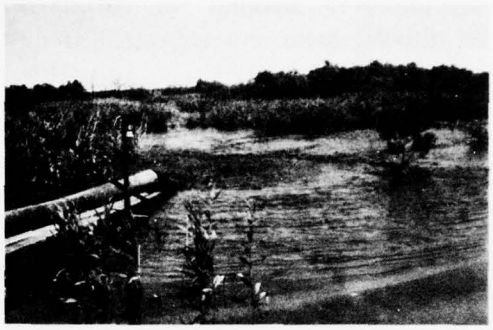
Present Practices—

Effective containment of dredged material is seldom achieved because of improper design and operation of diked disposal areas (e.g., short retention times and dike failures); however, technology for improvement is present and practical. (See Technical Report D-74-2.)

Retaining Dikes—

The construction of adequate dikes is often difficult because of poor materials and foundation conditions and is compounded by a prevailing lack of sufficient funds. Because responsibility for dike design, construction, and maintenance is often varied and diffuse and because no adequate guidance is available, a report is in preparation. (See Work Unit 2C04.)

Effluent Filtering–



Conventional filtering systems as well as innovative ones (pervious dikes, sandfill weirs, etc.) have been shown to be technically feasible for effluent quality improvement. Natural vegetation can also be an effective filter and mechanism for nutrient removal, but significant amounts of heavy metal contaminants cannot be removed. (See Contract Report D-76-8, Technical Report D-76-4, and Work Unit 2C15.)

Objectionable Environmental Conditions–

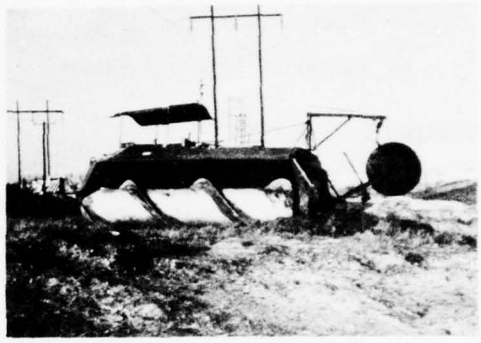
Public perception of and reactions to confined disposal areas are influenced by both real and presumed conditions of site effectiveness, where sites are located, and adverse biological, chemical, and physical conditions that can develop in them. (See Contract Report D-74-4.)

Mosquitoes and Malodors–

While regionally restricted or of localized nature, conditions conducive to mosquito propagation and malodors can develop in disposal areas. Effective control alternatives for both have been identified and tested. (See Contract Report D-76-9 and Work Unit 2C12.)

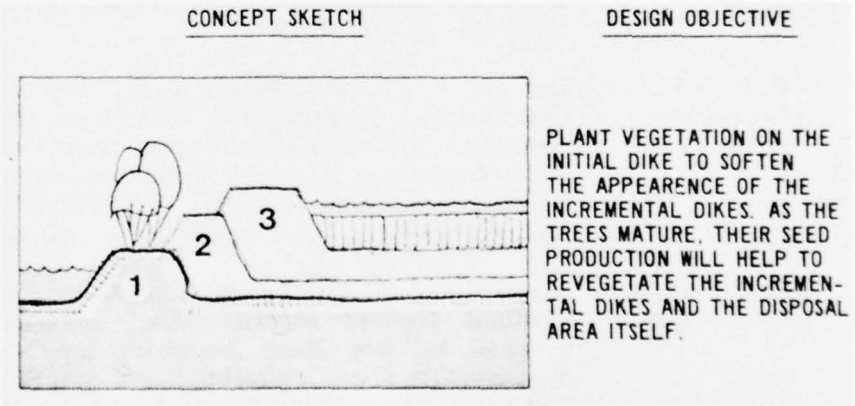
Construction Equipment–

Specialized yet available vehicles well suited for use in negotiating and performing work on the extremely weak deposits in many disposal areas have been identified, evaluated, tested, and demonstrated in several Corps Districts. (See Work Units 2C09A and B.)



Landscaping–

Guidance has been issued with documentation of landscaping techniques directly applicable to confined disposal areas. If considered in planning and design, landscaping can aid in achieving effective resolution of aesthetic problems while accomplishing dredged material disposal objectives in full. (See Contract Report D-75-5 and Work Unit 2C17.)



Vegetative Dewatering–

Certain plant species hold considerable promise for providing inexpensive dewatering of dredged material slurries in disposal areas; however, operational problems are present and are being investigated further. Effectiveness is being compared with that of mechanical methods of dewatering. (See Technical Report D-76-4 and Work Unit 2C10.)

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Design Guidelines. (See Work Unit 2C16.)

European Dredging Practices. (See Work Unit 2C14.)

REPORTS PUBLISHED. . . . .

TR D-74-2
(Work Unit 2C03)

Murphy W. L., and Zeigler, T. W., "Practices and Problems in the Confinement of Dredged Material in Corps of Engineers Projects," May 1974, Soils and Pavement Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD 780 753.

TR D-76-1
(Work Unit 2C08)

Johnson, L. D., "Mathematical Model for Predicting the Consolidation of Dredged Material in Confined Disposal Areas," February 1976, Soils and Pavements Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A020 949.

TR D-76-4
(Work Unit 2C02)

Lee, C. R. et al., "Feasibility of the Functional Use of Vegetation to Filter, Dewater, and Remove Contaminants from Dredged Material," June 1976, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A028 336.

CR D-74-4
(Work Unit 2C06)

Harrison, J. E., and Chisholm, L. C., "Identification of Objectionable Environmental Conditions and Issues Associated with Confined Disposal Areas," September 1974, prepared by Arthur D. Little, Inc., under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A000 895.

CR D-75-5
(Work Unit 5E01)

Mann, R., et al., "Landscape Concept Development for Confined Dredged Material Sites," December 1975, prepared by Roy Mann Associates, Inc., Cambridge, Massachusetts, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD 026 684.

CR D-76-8
(Work Unit 2C05)

Krizek, R. J., FitzPatrick, J. A., and Atmatzidis, D. K., "Investigation of Effluent Filtering Systems for Dredged Material Containment Facilities," August 1976, prepared by the Department of Civil Engineering, Northwestern University, Evanston, Illinois, under contract to U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

CR D-76-9
(Work Unit 2C11)

Harrison, W., et al., "Abatement of Malodors at Confined Dredged Material Disposal Sites," August 1976, prepared by Argonne National Laboratory, Argonne, Illinois, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

WORK UNITS. . . . .

2C02 Study of the Feasibility of the Functional Use of Vegetation for Slurry Filtering, Pollutant Constituent Removal, and Dredged Material Desiccation. EEL, WES. $52,330. Completed: final report published, TR D-76-4.

2C03 Problems and Practices in Current Disposal Methods. SPL, WES. $55,387. Completed: final report published, TR D-74-2.

2C04 Development of Design and Construction Guidelines for Dredged Material Retaining Dikes. Savannah District, CE. $63,895. Completed: report in press.

2C05 Analysis of Functional Capabilities and Performance of Pervious Dikes, Sandfill Weirs, and Related Effluent Filtering Systems. Department of Civil Engineering, Northwestern University. $86,786. Completed: final report published, CR D-76-8.

2C06 Identification of Nature and Distribution of Objectionable Environmental Conditions in Confined Disposal Areas. Arthur D. Little, Inc. $34,990. Completed: final report published, CR D-74-4.

2C08 Development of Guidelines for Containment Facility Design. Interlaboratory team, WES. $65,015. Completed: final report published, TR D-76-1.

2C09A Development of Concepts Using Low-Ground-Pressure Construction Equipment for Containment Area Operation and Maintenance (Equipment Inventory). MESL, WES. $24,600. Completed: report in press.

2C09B Development of Concepts Using Low-Ground-Pressure Construction Equipment for Containment Area Operation and Maintenance (Development of Field Evaluation Investigations). MESL, WES. $88,400. Active.

2C09C Procedures and Practices Used in Construction, Maintenance, and Management of Dredged Material Containment Areas. MESL, WES. $70,000. Active.

2C10 Demonstration of Dredged Material Drying by Use o Vegetation. Biological Water Purification, Inc. $27,500 Active.

2C11 Investigation of Physical, Chemical and/or Biological Treatmen for Odor Control in Dredged Material Disposal Areas. Argonn National Laboratory. $67,120. Completed: final repor published, CR D-76-9.

2C12 Investigation of Physical, Chemical, and/or Biological Contro of Mosquitoes in Dredged Material Disposal Areas. The Citade $71,845. Active.

2C14 European Dredging and Disposal Practices. Adriaan Volke Dredging Company. $83,800. Active: report in review.

2C15 Field Investigation of the Functional Use of Vegetation t Filter and Remove Contaminants from Existing Dredge Material Disposal Areas. EEL, WES. $25,000. Active.

2C16 Containment Area Design to Maximize Effectiveness o Confined Disposal Areas. Brian J. Gallagher and Co. $72,256 Active.

2C17 Public Information Brochure Regarding Land Plannin Principles and Landscape Design Concepts for Confine Dredged Material Disposal Facilities. Roy Mann Associates $9,984. Active.

4A16A Performance of Containment Areas Filled with Dredge Material. Massachusetts Institute of Technology. $99,500 Active: report in review.

5E01 Landscaping Concept Development for Confined Dredge Material Disposal Sites. Roy Mann Associates. $44,289 Completed: final report published, CR D-75-5.

DREDGED MATERIAL DENSIFICAT

(Task 5A: Disposal Operations Pro

OBJECTIVE. . . . .

— to develop and test promising techniques for dewatering or densifying dredged material using mechanical, biological, and/or chemical techniques prior to, during, and after placement in containment areas—

APPROACH. . . . .

— to develop and concepts through a phase program: I, lite and laboratory feas studies; II, field evalu III, development of alternatives—

STATUS. . . . .

— 21 total work units (5 contracts, 3 with cooperating CE ele 13 in-house) involving total expenditure/obligation of $1,396,00
— 4 work units completed; 1 report published, 1 report in
— final results to be presented in synthesis report on demonstrations and manual for alternative selection, design implementation.

RESULTS AND FINDINGS TO DATE. . . . .

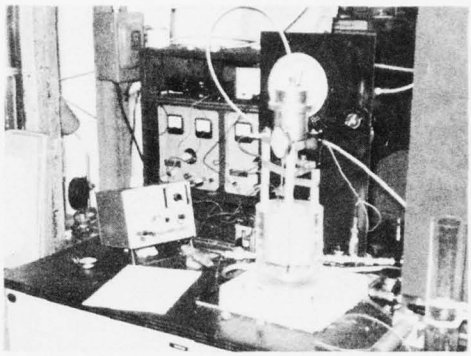
Phase I Studies—

Nine work units were initiated to study the technical feasibility of dewatering mechanisms.

Underdrain Dewatering—

Despite the conventional rule-of-thumb that fine-grained material be dewatered by gravity, a literature study and laboratory indicated this was a potentially feasible technique.

Freeze-Thaw Dewatering–



Testing has indicated that cyclic freeze-thaw behavior results in significant consolidation of fine-grained dredged material and the permeability is greatly increased during the thaw cycles.

Electro-Osmotic Dewatering–

Laboratory studies indicated that very low voltage gradient electro-osmosis would significantly dewater fine-grained dredged material, with 30-45 kwhr needed to create a cubic metre of disposal volume.

Sand Injection Dewatering–

A small test verified that a 1:1 fine sand-water slurry could be injected into fine-grained dredged material, fracturing the mass to produce internal horizontal drainage layers. Pumping rate from wellpoints in the layers was 20 times greater than from conventional wellpoints placed in the same material.

AD-A043 409 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MISS F/G 13/2
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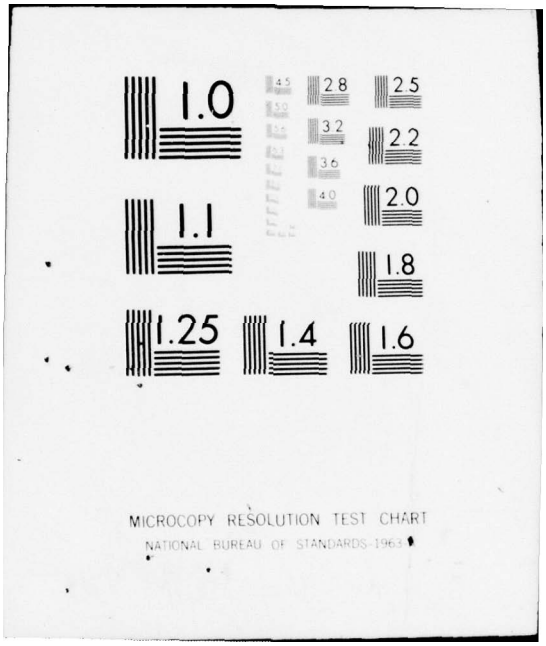
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963

Phase II Studies–

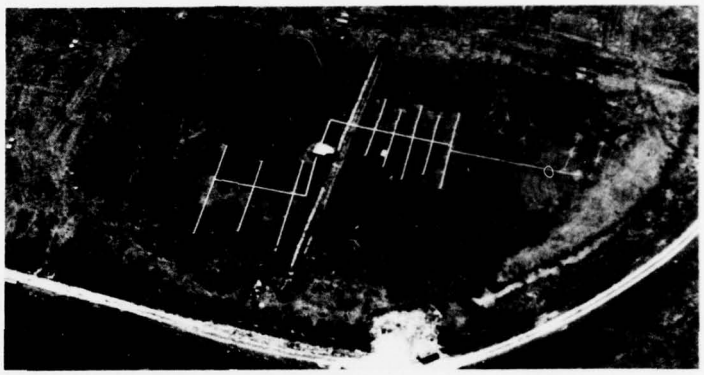
Nine work units were initiated for field evaluation of promising concepts, based on the results of Phase I studies. All field evaluations were conducted in the 84-acre Upper Polecat Bay Disposal Area, Mobile, Alabama, provided by the cooperation of the USAE District, Mobile.

Progressive Trenching–

Fine-grained dredged material placed in most confined disposal areas tends to remain at high moisture contents for extended periods, neither consolidating under its own weight nor drying. By trenching the surface of disposal areas to improve surface drainage, natural evaporative forces may be used to economically dry the dredged material back into solid form, resulting in a significant increase in available storage volume and providing a material suitable for dike raising or other productive uses. The DMRP has conducted research involving a wide range of trenching equipment and methods needed to work in confined disposal areas and promote natural drying and desiccation.

Vacuum Wellpoint Dewatering–

To investigate the effects of after-the-fact internal dredged material dewatering and vacuum surcharging, a field demonstration of dewatering by vacum wellpoints is being conducted.



Periodic Crust Mixing–

In an attempt to increase the drying rate and improve engineering properties, a field demonstration of periodically mixing dried surface crust with underlying very wet dredged material is being conducted.

Capillary Wick Dewatering–

Capillary wicks may have potential for low-cost maintenance-free dewatering at depth of fine-grained dredged material. To test this possibility a field demonstration of the process is being conducted.

Underdrain Dewatering–

Large-scale test pits have been constructed and filled with fine-grained dredged material to evaluate the effects of gravity and vacuum-assisted underdrainage and seepage consolidation as methods for dewatering dredged material.

Phase III Studies–

Three work units have been initiated (predictive modeling, technology implementation, and design alternative development) to ensure that the results of the research will be presented in a form useful to CE field elements.

REPORTS PUBLISHED. . . . .

CR D-74-5 **(Work Unit 5A01)** "Methodology for Dredged Material Reclamation and Drainage," November 1973, prepared by Dames & Moore, under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A000 896.

WORK UNITS. . . . .

5A01 Methodology for Dredged Material Reclamation and Drainage. Dames & Moore. $55,858. Completed: final report published, CR D-74-5.

5A02 Laboratory Study of Dredged Material Slurry Water Loss Due to Mechanical Agitation. EEL, WES. $49,235. Active: report in review.

5A03 State-of-the-Art Survey and Evaluation of Current Physical, Mechanical, and Chemical Dewatering and Densification Techniques. SPL, WES. $57,117. Active: report in review.

5A04 A Laboratory Study to Determine the Variables that Influence the Electro-Osmotic Dewatering of Dredged Material. KMA Research Institute. $96,828. Completed.*

* Report will be an appendix to a field site report.

5A05 A Laboratory Study of Aeration as a Feasible Technique for Dewatering Fine-Grained Dredged Material. Environmental Engineering Consultants, Inc. $49,265. Completed: report in press.

5A06 Feasibility Study of General Crust Management as a Technique for Increasing Capacities of Dredged Material Containment Areas. Texas A&M University. $53,529. Active: report in review.

5A07 Feasibility of Frost Action for Densification of Dredged Material. CRREL. $64,965. Active: report in review.

5A08 Mobile (Alabama) Field Study. EEL, WES. $91,000. Active.*

5A09 Feasibility Study of Consolidating Fine-Grained Dredged Material with Windmill-Powered Vacuum Well Points. EEL, WES. $126,000. Active.*

5A10 Development of Capillary Enhancement Devices for Dewatering Fine-Grained Dredged Material. SPL, WES. $65,000. Active.*

5A11 Feasibility of Injecting Fine-Grained Sand Slurry into Dredged Material. SPL and EEL, WES. $15,000. Completed.*

5A12 Acquisition of Meteorological Data for Ongoing Dredged Material Research Studies at the Mobile Test Site. MESL, WES. $49,200. Active.*

5A13 Containment Area Management as a Means of Promoting Densification of Fine-Grained Dredged Material. EEL, WES. $50,000. Active.

5A14 Mechanical Stabilization of Fine-Grained Dredged Material by Periodic Mixing in of Dried Surface Crust. MESL, WES. $33,000. Active.*

5A15 Field Evaluation of Slurry Densification by Underdrainage Techniques. SPL, WES. $225,000. Active.*

5A16 Development of Dewatering Alternatives Manual for the Mobile District. Mobile District. $25,000. Active.

5A17 Field Demonstration of Electro-Osmotic Dewatering of Fine-Grained Dredged Material Slurry. Mobile District. $85,000. Active.*

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* Report will be an appendix to a field site report.

5A18 Vegetative Dewatering Field Demonstration. Dauphin Island Sea Lab. $44,000. Active.*

5A19 Development of Containment Area Sizing Methodology Considering Effects of Dredged Material Dewatering. EEL, WES. $45,000. Active.

5A20 Implementation of Task 5A Technology. SPL, WES, $81,000. Active.

5A21 Task 5A Design Alternatives Development. EEL, WES. $35,000. Active.

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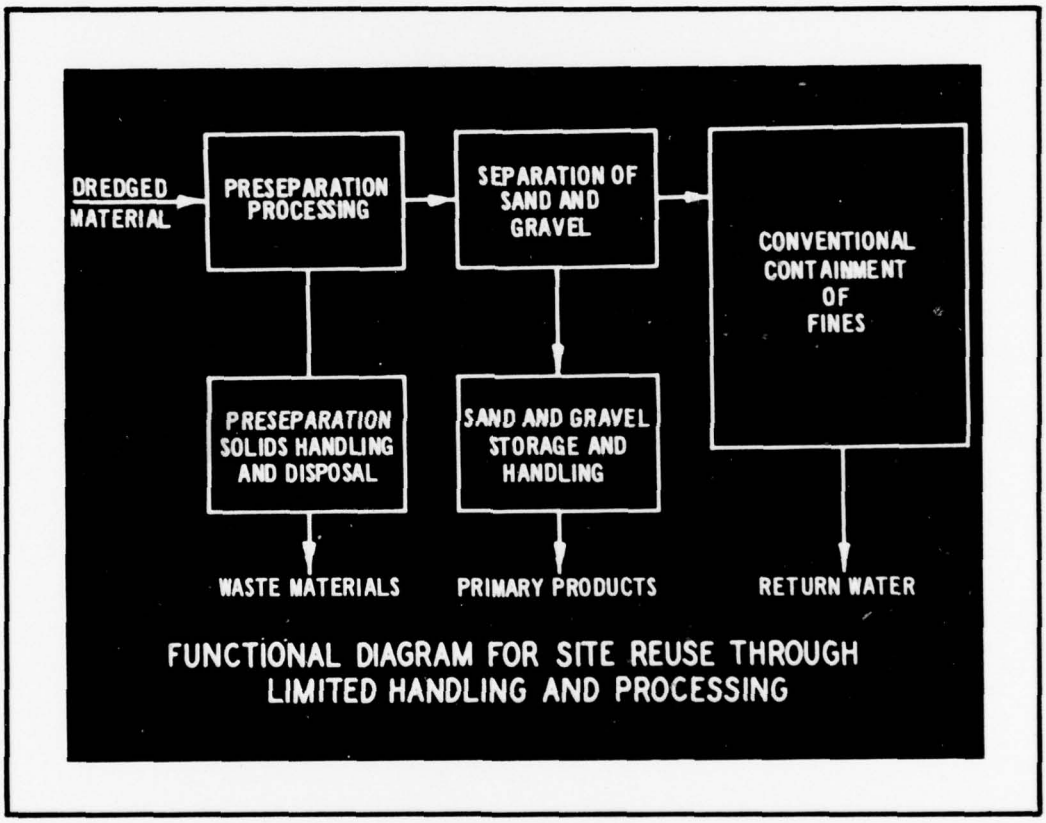
* Report will be an appendix to a field site report.

DISPOSAL AREA REUSE

(Task 5C: Disposal Operations Project)



FUNCTIONAL DIAGRAM FOR SITE REUSE THROUGH LIMITED HANDLING AND PROCESSING

OBJECTIVE. . . . .

— to investigate dredged material improvement and rehandling procedures aimed at permitting the removal of material from containment areas for landfill or other uses elsewhere–

APPROACH. . . . .

— develop and evaluate procedures for maintaining disposal areas convenient to dredging operations for indefinite periods while ensuring that disposal operations remain environmentally acceptable and operational; develop and evaluate disposal area reuse management practices to extend the capacity and useful life of dredged material disposal areas such that the need for new disposal areas is kept to a minimum–

STATUS. . . . .

— 11 work units (3 in-house efforts, 6 contracts, 2 interagency agreements) involving an aggregate expenditure/obligation of $796,660.
— 6 work units completed; 3 reports and 2 miscellaneous papers published; 2 work units resulted in special purpose information transfer documents.
— final results to be presented in a total of 11 formal documents, 2 special purpose information transfer documents, and 1 synthesis report.

RESULTS AND FINDINGS TO DATE. . . . .

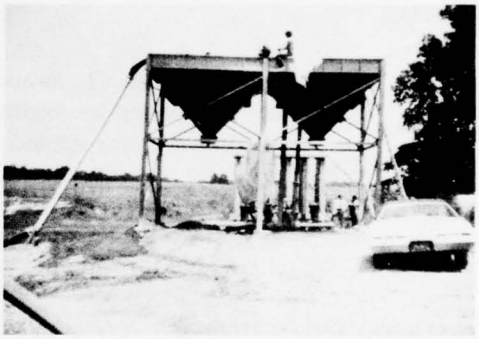
Present Practices–

Confining dredged material on land has changed little since inception: sites still have a short life span meaning that abandoned sites are proliferating and land requirements for new ones continue in the face of land scarcity, rising costs, and public objection. (See Work Unit 5C09.)

Disposal Area Reuse Management (DARM)–

The DARM concept has been developed based on consultations with Corps Districts and results of DMRP research. Under this concept, the disposal area is a collection and processing site where valuable portions of the dredged material are made available for productive uses while unusable material is, if necessary, treated and disposed of. (See MP D-76-15 and MP D-76-16.)

Separation and Handling–

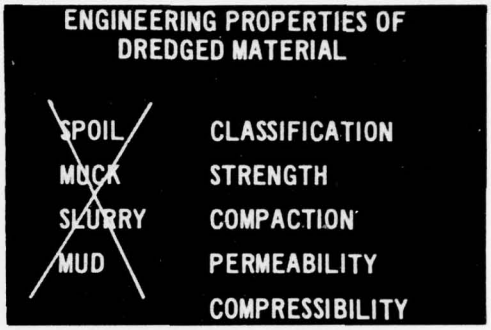


Research has indicated that separation of sand, gravel, and silt fractions from dredged slurries is technically and, in many cases, economically feasible using commercially available equipment and separation basins. Additional cost benefits result because removal of the material increases the available storage volume. (See Work Units 5C01 and 5C01A; CR D-74-6.)

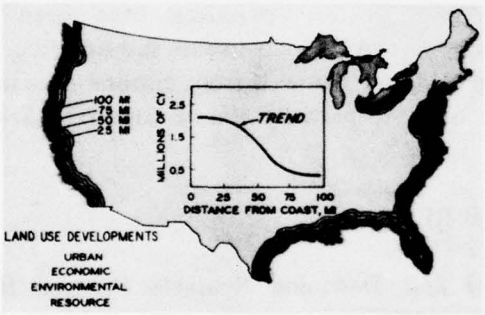
Engineering and Physical Properties–

Results show that dewatered dredged material is a soil exhibiting engineering and physical properties similar to those of other natural soils. Most dredged

material when adequately dewatered is acceptable landfill material. It is recommended that the Unified Soil Classification System be used in describing dredged material rather than by such negative terms as muck, spoil, sludge, or mud. (See Work Unit 5C02.)



Landfill and Construction Material Needs–

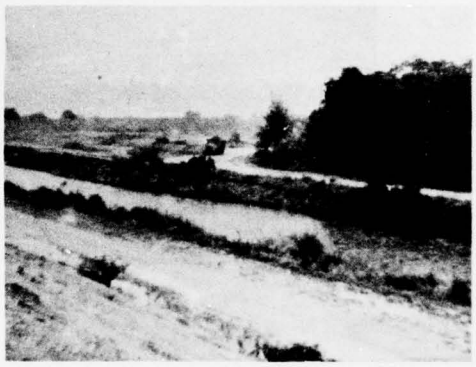


In many urbanized areas there is a severe shortage of suitable landfill and construction material. Research indicates a high demand for landfill requirements in coastal areas and a decreasing demand inland. The total demand for dredged material was in excess of available materials from dredging activities. (See Work Unit 5C04; CR D-74-2.)

The Reusable Site–

A reusable site is considered to be one where planning and operations are carried out to extend its life. Site reuse in its simplest form involves dewatering and densification of dredged material in containment areas by promoting natural drainage and drying processes. Additional measures may be taken to further extend capacity through removal of material from the site for productive uses. (See MP D-76-15 and MP D-76-16.)

DARM Practices Within CE Districts–



With confined disposal sites in many areas nearing their limit of capacity, the requirements for maximum utilization of existing sites are being seriously considered. In many cases long-range plans for acquisition of additional disposal sites have been abandoned due to environmental considerations. DARM practices have been implemented in varying degrees by several Districts to ease this situation. Usable dredged material is being sold and removed from disposal sites in many areas and used as fill in order to partially restore capacity. (See Work Unit 5C09.)

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Procedures for Selecting and Designing Reusable Dredged Material Disposal Sites. (See Work Unit 5C05.)

Methodology for Designing Fine-Grained Dredged Material Sedimentation Basins. (See Work Unit 5C11.)

REPORTS PUBLISHED. . . . .

CR D-74-2
(Work Unit 5C04)

Reikenis, R., Elias, V., and Drabkowski, E. F., "Regional Landfill and Construction Material Needs in Terms of Dredged Material Characteristics and Availability," Vols I and II, May 1974, prepared by Green Associates, Inc., under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS Nos. AD 780 750 and AD 780 751.

CR D-74-6
(Work Unit 5C01)

Mallory, C. W., and Nawrocki, M. A., "Containment Area Facility Concepts for Dredged Material Separation, Drying, and Rehandling." October 1974, prepared by Hittman Associates, Inc., under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A002 605.

CR D-74-7
(Work Unit 5C06)

Wakeford, R. C., and MacDonald, D., "Legal, Policy, and Institutional Constraints Associated with Dredged Material Marketing and Land Enhancement," December 1974, prepared by American Technical Assistance Corporation under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A006 595.

MP D-76-15

Palermo, M. R., and Montgomery, R. L., "A New Concept for Dredged Material Disposal," February 1976, Environmental Effects Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

MP D-76-16

Montgomery, R. L., and Palermo, M. R., "First Steps Toward Achieving Disposal Area Reuse," April 1976, Environmental Effects Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

WORK UNITS. . . . .

5C01

Concept Development for Appurtenant Containment Area Facilities for Dredged Material Separation, Drying, and Rehandling. Hittman Associates. $94,968. Completed: final report published, CR D-74-6.

5C01A

Concept Development....Field Evaluation. Hittman Associates. $10,587. Completed: no formal report planned.

5C02

Classification and Determination of Engineering and Other Physical Characteristics of Dredged Material. EEL, WES. $94,424. Completed: final report in press.

5C03

Systems Cost Analysis of Confined Disposal Practices. CERL. $75,000. Completed: no report planned.

5C04

Study of Regional Landfill and Construction Material Needs in Terms of Dredged Material Characteristics and Availability. Green Associates, Inc. $66,793. Completed: final report published, CR D-74-2 Vols I and II.

5C05

Development of Procedures for Selecting and Designing Reusable Dredged Material Disposal Sites. Acres American, Inc. $90,000. Active.

5C06

Investigation of Legal, Policy, and Institutional Constraints Associated with Dredged Material Marketing and Land Enhancement. American Technical Assistance Corporation. $56,653. Completed: final report published, CR D-74-7.

5C07 Feasibility Study of Vacuum Filtration Systems for Dewatering Dredged Material. Ryckman/Edgerly/Tomlinson & Associates. $78,531. Active.

5C08 Identification of Alternative Power Sources for Dredged Material Disposal Operations. Naval Construction Battalion Center, Engineering Laboratory. $86,000. Active.

5C09 Survey of Districts for Needs and Areas of Potential Application for Disposal Area Reuse. EEL, WES. $46,710. Active.

5C11 Development of Methodology for Designing Fine-Grained Dredged Material Sedimentation Basins. EEL, WES. $97,000. Active.

TREATMENT OF CONTAMINATED DREDGED MATERIAL

(Task 6B: Disposal Operations Project)

OBJECTIVE. . . . .

— to evaluate chemical, physical, and/or biological methods for the removal and recycling of dredged material constituents–

APPROACH. . . . .

— through laboratory and field investigation, develop methodologies, guidelines, and recommendations for treatment of dredged material to meet water-quality criteria–

STATUS. . . . .

— 7 work units (2 in-house efforts, 5 contracts) involving an aggregate expenditure/obligation of $592,120.
— 2 work units completed; 1 report published.
— final results to be presented in 5 reports and 1 synthesis document.

RESULTS AND FINDINGS TO DATE. . . . .

Available Treatment Processes–

Results of a survey of conventional physical, chemical, and biological unit processes indicated that emphasis should be placed upon the physical/chemical processes as probably being the best treatment methods. Conventional biological treatment is generally ineffective because of the low soluble organic content of dredged material. (See Work Unit 6B01.)

Laboratory Treatability Studies–

Laboratory studies were performed to determine the amenability of contaminated dredged material to treatment by physical, chemical, and biological processes. Results indicated that most conventional treatment techniques are not applicable or are impractical due to the relatively low soluble organic content, usually high volumes, and variable nature of the material being dredged. Two methods that hold the

most promise are in-line oxygenation to alleviate dissolved oxygen decreases in the water column during open-water disposal operations and chemical coagulation for confined area operations. (See TR D-76-2.)

Oil and Grease Problems–

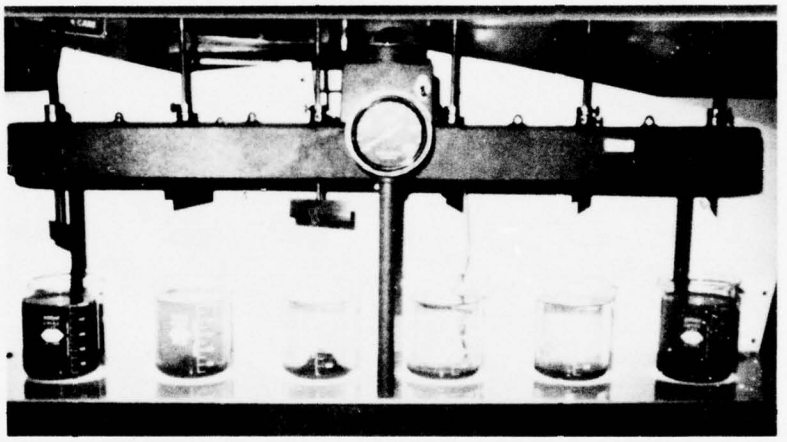
DMRP studies indicated that in oil- and grease-laden sediments, the oil and grease tend to remain tightly bound to the sediment and are not released by the dredging process. Bench-scale laboratory studies were performed to confirm the findings of the field surveys and to study the significant parameters involved in oil release mechanisms. (See Work Unit 6B05.)

Oxygenation of Dredged Material–

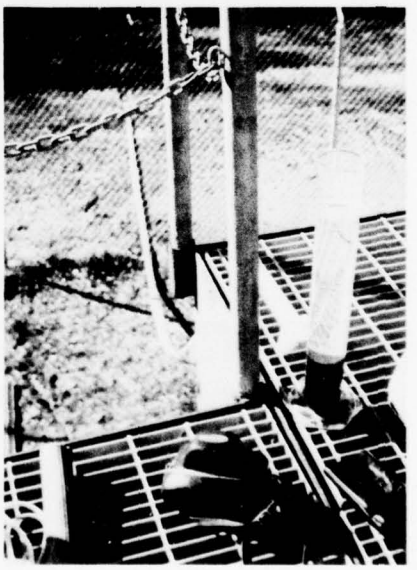
To develop methods to alleviate the dissolved oxygen reduction in the water column associated with open-water disposal of dredged material, laboratory investigations and two field studies were performed. Oxygen and air were used as the source oxidant and were injected directly into the dredge discharge. Dissolved oxygen and other parameters were monitored during testing to determine effectiveness. Pure oxygen proved to be the most effective in reducing dissolved oxygen depletion in the water column. (See Work Unit 6B06.)

Chemical Coagulation Studies–

LABORATORY STUDIES. An extensive evaluation was performed of various chemicals to be used in removing contaminants from dredged material by coagulation/flocculation/sedimentation. Results indicated that the contaminants are usually tied up with the solids fraction of dredged material and coagulation/flocculation of the fine particles is an effective means of contaminant removal. (See Work Units 6B07, 6B08.)



DESIGN AND OPERATIONAL PROCEDURES. Laboratory and field investigations were performed to verify effectiveness and establish procedures and guidelines for design of chemical treatment systems for disposal areas. Extensive jar test analyses and a pilot plant operation were performed in the field, resulting in significant reductions in the turbidity of the site effluent water. (See Work Unit 6B08.)



Contaminant Removal with Vegetation–

A potential problem associated with large-scale upland disposal of dredged material is possible contamination of adjacent waterways by disposal area effluents. A salt marsh system was evaluated to determine its ability to remove contaminants from the effluent of a confined disposal area. General objectives were to evaluate the relative efficiency of the marsh system to extract selected metals and nutrients and the processes responsible for extraction. (See Work Unit 6B09.)

REPORTS PUBLISHED. . . . .

TR D-76-2
(Work Unit 6B02)

Moore, T. K., and Newbry, B. W., "Treatability of Dredged Material (Laboratory Study)," February 1976, Environmental Effects Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

WORK UNITS. . . . .

6B01 Assessment of Chemical, Physical, and Biological Processes for Treatment of Dredged Material. JBF Scientific Corporation. $41,900. Completed: no formal report planned.

6B02 Laboratory Treatability Studies of Polluted Dredged Material. EEL, WES. $125,772. Completed: final report published, TR D-76-2.

6B05 An Evaluation of Oil and Grease Contamination Associated with Dredged Material. Engineering Science, Inc. $74,537. Active.

6B06 Research Study on Oxygenation of Dredged Materials. JBF Scientific Corporation. $99,850. Active.

6B07 Flocculation as a Means for Water-Quality Improvement from Disposal of Dredged Material in Confined Areas. University of Southern California. $98,800. Active.

6B08 Development and Application of Design and Operational Procedures for Coagulation of Dredged Material Slurries and Diked Area Effluents. EEL, WES. $74,700. Active.

6B09 Field Verification of the Function Use of Vegetation to Remove Contaminating Constituents of Effluents from Dredged Material Disposal Areas. Dr. H. L. Windom. $76,560. Active.

TURBIDITY PREDICTION AND CONTROL

(Task 6C: Disposal Operations Project)

OBJECTIVE. . . . .

— to investigate the problem of turbidity and develop a predictive capability as well as physical and chemical control methods for employment in both dredging and disposal operations–

APPROACH. . . . .

— develop an empirical model based on field and laboratory data for predicting the nature of turbidity plumes generated by open-water pipeline disposal operations; evaluate, develop, demonstrate, and prepare guidelines for controlling turbidity at dredging and disposal operations–

STATUS. . . . .

— 8 work units (1 in-house effort, 7 contracts) involving an aggregate expenditure/obligation of $849,100.
— 2 work units completed; 1 report published.
— final results to be presented in 6 additional reports and 1 synthesis document.

RESULTS AND FINDINGS TO DATE. . . . .

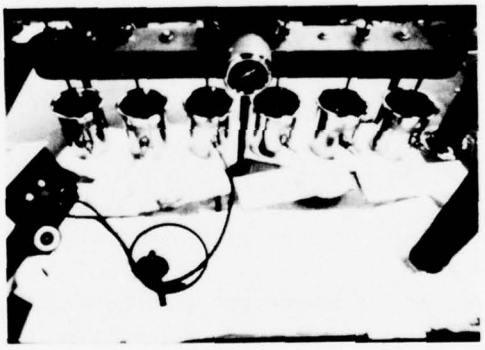
Operational Techniques–

Good dredging procedures, already known but not always practiced, will not only reduce dredge-induced turbidity but also will result in a more economical operation. Dredge-induced turbidity is normally restricted to the immediate vicinity of the dredge plant. (See Contract Report D-76-4.)

Silt Curtains–

Data collected from various field operations indicate that under rather quiescent conditions silt curtains which are properly deployed and maintained can be effective in controlling the dispersion of turbid water generated by disposal operations. The vast majority of the dredged material disposed inside a curtained area forms a fluid mud layer on the bottom which probably flows out under the silt curtain. (See Work Unit 6C06.)

Laboratory Turbidity Study–



A detailed laboratory study (settling columns) of fine-grained sediment shows that the settling characteristics (in column) are apparently controlled primarily by the sediment concentration in the water column, the salinity of the water, and the percent organics in the sediment. (See Work Unit 6C01.)

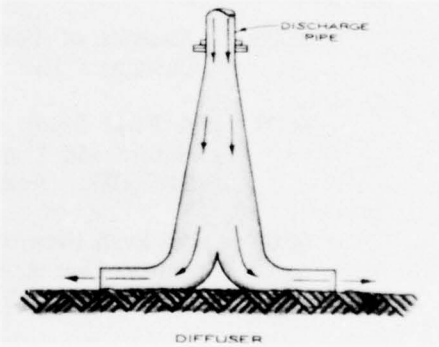
Open-Water Pipeline Disposal–

The vast majority of dredged material slurry deposited in open-water disposal areas descends to the bottom and forms a fluid mud layer in the immediate vicinity of the discharge pipe. Depending on the nature of the dredged material, the characteristics and duration of the operation, and the hydrodynamic regime, the thickness of the fluid mud may range from 3 to 6 feet at the discharge and decrease to a thickness of 1 foot or less at a distance of 800 to 1200 feet from the discharge. Suspended solids concentrations within the fluid mud layer typically range

from 10 to 200 g/ℓ but may be as high as 500 g/ℓ. (See Work Unit 6C07.) A small percentage of the material will remain suspended in the water column to form a turbidity plume. The characteristics of these plumes are controlled to a large extent by the discharge configuration and the currents present at the disposal site. (See Work Unit 6C02.)

Submerged Discharge–

To minimize the upward mixing of turbid water into the water column at an open-water pipeline disposal operation, a diffuser, which can be used on the discharge, is being designed and tested in a laboratory flume. The diffuser will dissipate the momentum yet maintain the high solids content of the dredged material slurry during disposal. (See Work Unit 6C08.)



TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Fluid Mud Flume Tests. (See Work Unit 6C09.)

REPORTS PUBLISHED. . . . .

CR D-76-4
(Work Unit 6C03)

Huston, J. W., and Huston, W. C., "Techniques for Reducing Turbidity During Dredging Operations," May 1976, prepared by John Huston, Inc., under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A26 623.

WORK UNITS. . . . .

6C01 Laboratory Study Related to Predicting the Turbidity-Generation Potential of Sediments to be Dredged. Walden Research Division of ABCOR, Inc. $110,206. Active.

6C02 Field Investigation of the Nature, Degree, and Extent of Turbidity Generated by Open-Water Pipeline Disposal Operations. State University of New York at Stony Brook. $192,863. Active.

6C03 Investigation of Techniques for Reducing Turbidity Associated with Present Dredging Procedures and Operations. John Huston, Inc. $49,280. Completed: final report published, CR D-76-4.

6C04 Assessment of Chemical Flocculants and Friction-Reducing Agents for Application in Dredging and Dredged Material Disposal. SPL, WES. $33,430. Completed: no formal report planned.

6C06 Analysis of Functional Capabilities and Performance of Silt Curtains. JBF Scientific Corp. $123,281. Active.

6C07 A Field Study of Fluid Mud Dredged Material: Its Physical Nature and Dispersion. Virginia Institute of Marine Science. $147,053. Active.

6C08 An Evaluation of the Submerged Discharge of Dredged Material Slurry During Pipeline Dredge Operations. JBF Scientific Corporation. $93,073. Active.

6C09 Laboratory Investigation of the Dynamics of Mud Flows Generated by Open-Water Pipeline Disposal Operations. JBF Scientific Corporation. $90,142. Active.

UPLAND DISPOSAL CONCEPTS DEVELOPMENT

(Task 3B: Productive Uses Project)

OBJECTIVE. . . . .

— to evaluate disposal alternatives such as using abandoned pits and mines and to investigate systems for the long-distance transport of dredged material to inland disposal areas–

APPROACH. . . . .

— develop comprehensive site selection guidelines covering the technical, economic, and social considerations of inland disposal; develop the technical and economic information needed to consider the long distance inland transportation of dredged material–

STATUS. . . . .

— 2 work units (contracts) involving a total expenditure/obligation of $180,565.
— all contracts active.
— final results to be presented in 2 contract reports plus 1 synthesis document that will combine output from Tasks 3B and 4C.

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Transport Concepts. (See Work Unit 3B01.)

Literature Review–Inland Disposal. (See Work Unit 3B02.)

WORK UNITS. . . . .

3B01 A Study of Dredged Material Transport Systems for Inland Disposal and/or Productive Uses Concepts. General Research Corporation. $137,092. Active.

3B02 Feasibility of Inland Disposal of Dredged Material: Literature Review. SCS Engineers. $43,473. Active.

LAND IMPROVEMENT CONCEPTS

(Task 4C: Productive Uses Project)

OBJECTIVE. . . . .

— to evaluate the use of dredged material as a resource for the development, enhancement, or restoration of land for agricultural or other uses–

APPROACH. . . . .

— consider dredged material as a valuable resource out of place or one for which a specific use has not been found; investigate various schemes to determine their potential for disposal use–

STATUS. . . . .

— 3 work units (1 contract, 1 interagency agreement, 1 in-house effort) involving a total expenditure/obligation of $241,400.

— 1 work unit has been completed; 2 are active; and 1 is being planned.

— final results will be published in 4 contract reports, 1 in-house report, and 1 synthesis document that will combine output from Tasks 3B and 4C.

RESULTS AND FINDINGS TO DATE. . . . .

Laboratory Strip-Mine Study–

Subject to some constraints, dredged material could be used to reclaim strip-mined areas, but before it is done on a large scale some smaller field experiments should be conducted. (See Work Unit 4C01.)

TOO EARLY FOR SIGNIFICANT FINDINGS. . . . .

Use of Dredged Material in Solid Waste Management. (See Work Unit 4C02.)

Dredged Material as an Agricultural Soil. (See Work Unit 4C03.)

Strip-Mine Reclamation Field Demonstration. (See Work Unit 4C04.)

WORK UNITS. . . . .

4C01 Use of Dredged Material to Reclaim Strip-Mined Land: A Preliminary Investigation. U. S. Bureau of Mines. $5,000. Completed: no formal report planned.

4C02 A Feasibility Study of Dredged Material Use in Conjunction with Solid Waste Management. EEL, WES. $34,000. Active.

4C03 Potential of Dredged Material as an Agriculture Soil and/or Amendment. Agricultural Research Service. $202,400. Active.

4C04 Strip-Mine Field Demonstration. Being planned.

PRODUCTS DEVELOPMENT

(Task 4D: Productive Uses Project)

OBJECTIVE. . . . .

— to investigate the technical and economic aspects of the manufacture of marketable products–

APPROACH. . . . . .

— determine what marketable commodities might be produced from dredged material or from the use of a disposal site–

STATUS. . . . .

— 3 work units (contracts) involving a total expenditure of $267,660.
— 1 work unit completed; 1 report published, 1 report in review, and 1 work unit still active.
— final results to be presented in 3 contract reports.

RESULTS AND FINDINGS TO DATE. . . . .

Lawn Sod–

Subject to certain constraints, commercial production of lawn sod, nursery products, foliage plants, and Christmas trees is feasible on mature disposal sites. On the other hand, production of horticultural crops on active disposal sites is not recommended. (See Work Unit 4D01.)

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Mariculture as an Alternative. (See Work Unit 4C02.)

Mariculture Field Demonstration. (See Work Unit 4D03.)

REPORTS PUBLISHED. . . . .

CR D-75-1 **(Work Unit 4D01)** — A. D. Little, Inc., "A Feasibility of Study of Lawn Sod Production and/or Related Activities on Dredged Material Disposal Sites," January 1975, prepared under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. NTIS No. AD A006 609.

WORK UNITS. . . . .

4D01 A Feasibility Study of Lawn Sod Production and/or Related Activities on Dredged Material Disposal Sites. Arthur D. Little, Inc. $39,566. Completed: final report published, CR D-75-1.

4D02 Investigation of Mariculture as an Alternative Use of Dredged Material Containment Areas. Dow Chemical Company. $94,572. Active.

4D03 Demonstration of Marine Shrimp Culture in an Active Dredged Material Containment Area. Dow Chemical Company. $133,526. Active.

DISPOSAL AREA LAND-USE CONCEPTS

(Task 5D: Productive Uses Project)

OBJECTIVE. . . . .

— to assess the technical and economic aspects of the development of disposal areas as landfill sites and to develop recreation-oriented and other public or private land-use concepts–

APPROACH. . . . .

— investigate issues associated with creating shoreline or offshore recreational areas, compare case studies of productive land-use issues, evaluate legal/regulatory impacts, develop created-land valuation techniques, compile handbook for productive land-use implementation–

STATUS. . . . .

— 6 work units (3 contracts involving an aggregate expenditure/obligation of $438,780; 2 work units being advertised; 1 being planned).
— 1 work unit completed and report published.
— final results to be presented in 4 additional contract reports and 1 synthesis document.

RESULTS AND FINDINGS TO DATE. . . . .

Creation of Recreation Land–

Dredged material can be used in an economically efficient manner to create recreational land in urban areas. Environmental concerns are not an insurmountable barrier; however, financial resources available to local communities to develop the recreational potential of disposal sites may be the most significant constraint. An econometric model was proposed that will allow planners to assess recreational area needs and potential value. The initiative and attitude taken by the Corps, in concert with local or regional planners, toward recreational use of dredged material will determine in many cases the extent of implementation. (See Contract Report D-76-6.)

TOO EARLY FOR SIGNIFICANT RESULTS. . . . .

Comparative Analyses of Associated Land-Use Issues. (See Work Unit 5D02.)

Legal/Regulatory Impacts. (See Work Unit 5D04.)

Techniques for Appraising Created Land. (See Work Unit 5D05.)

Land Use Implementation Guidelines. (See Work Unit 5D06.)

REPORTS PUBLISHED. . . . .

CR D-76-6
(Work Unit 5D01)

Skjei, S. S., "Socio-Economic Aspects of Dredged Material Disposal: Creation of Waterfront Recreational Opportunities in Urbanized Areas," May 1976, prepared by University of Virginia under contract to the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

WORK UNITS. . . . .

5D01 Socio-Economic Aspects of Dredged Material Disposal: Creation of Waterfront Recreational Opportunities in Urbanized Areas. University of Virginia. $163,817. Completed: final report published, CR D-76-6.

5D02 Case Studies and Comparative Analyses of Issues Associated with Productive Land Use at Dredged Material Disposal Sites. Energy Resources Company, Inc. $245,866. Active.

5D03 Productive Land Use of Dredged Material Containment Areas: International Literature Review. Beeman/Benkendorf. $29,097. Active: report being reviewed.

5D04 Evaluation of Laws and Regulations Impacting the Land Use of Dredged Material Containment Areas. Contract being advertised.

5D05 Determination of Value of Land and Associated Benefits Created by Dredged Material Containment. Contract being advertised.

5D06 Guidelines for Productive Land Use of Dredged Material Containment Areas. Being planned.

RESEARCH RESULTS APPLICATIONS

(DMRP Task 9A)

OBJECTIVE. . . . .

— to ensure the timely application of the results of the DMRP in project planning, design, implementation, and regulation through the effective dissemination of information within the Corps and to all relevant outside groups–

APPROACH. . . . .

— continue to expand the scope and intensity of information dissemination and transfer activities; assess the effectiveness of the activities; investigate requirements for a final, programwide technology transfer system and data retrieval mechanism–

STATUS. . . . .

— 1 work unit (contract) completed involving a total expenditure of $142,785.
— approximately 21 percent of all DMRP funds already expended for information/technology transfer activities (reports, bulletins, briefings, workshops, committees, presentations, etc).
— plans being finalized for a contract effort to develop an index and retrieval system for all DMRP results.

RESULTS AND FINDINGS TO DATE. . . . .

Present Activities–

DMRP information dissemination/transfer activities are unparalleled within the Corps; however, in spite of no means of gaging effectiveness, they are still considered to be inadequate. Major emphasis is being placed on activities that permit interpersonal contacts with information users to increase effectiveness.

System Design Requirements–

The contract study concluded a DMRP information transfer system is needed that will facilitate the correlation of applicable information to Corps project requirements and that will present the information in a systematic and topically organized format.

WORK UNITS. . . . .

9A01 Information Dissemination and Technology Transfer System for the Dredged Material Research Program. Teknekron, Inc. $142,786. Complete: report in press.

ACKNOWLEDGMENT. . . . .

This report was prepared primarily by Dr. R. T. Saucier with the direct assistance of Mr. C. C. Calhoun, Jr., Dr. R. M. Engler, Mr. T. R. Patin, and Dr. H. K. Smith (see page 8 for titles and organizational positions). Graphic arts and editorial assistance were furnished by personnel of the Technical Communications Group, EEL, WES, under the direction of Ms. D. P. Booth. All work was accomplished under the general supervision of Dr. John Harrison, Chief of the EEL.

Director of the WES during 1976 was COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

Dredged Material
Research Program

FOURTH ANNUAL REPORT

January 1977

Environmental Effects Laboratory
U. S. Army Engineer
Waterways Experiment Station
CORPS OF ENGINEERS
Vicksburg, Mississippi

The 4th ANNUAL REPORT of the Corps of Engineers' Dredged Material Research Program provides a concise overview of the objectives, scope, structure, and related aspects of this comprehensive, nationwide, 5-year research effort. Emphasis in the report is on highlights of and progress made during calendar year 1976. In keeping with the philosophy of the program to disseminate information and results as widely as possible, copies of the 4th ANNUAL REPORT are available free of charge as long as supplies last. Please use the order card attached should your organization desire an additional copy or to request a copy be sent to another individual/organization.

Dredged Material
Research Program

FOURTH ANNUAL REPORT

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The Houp
Dredging spoil site
now a shrimp farm

The TEXAN
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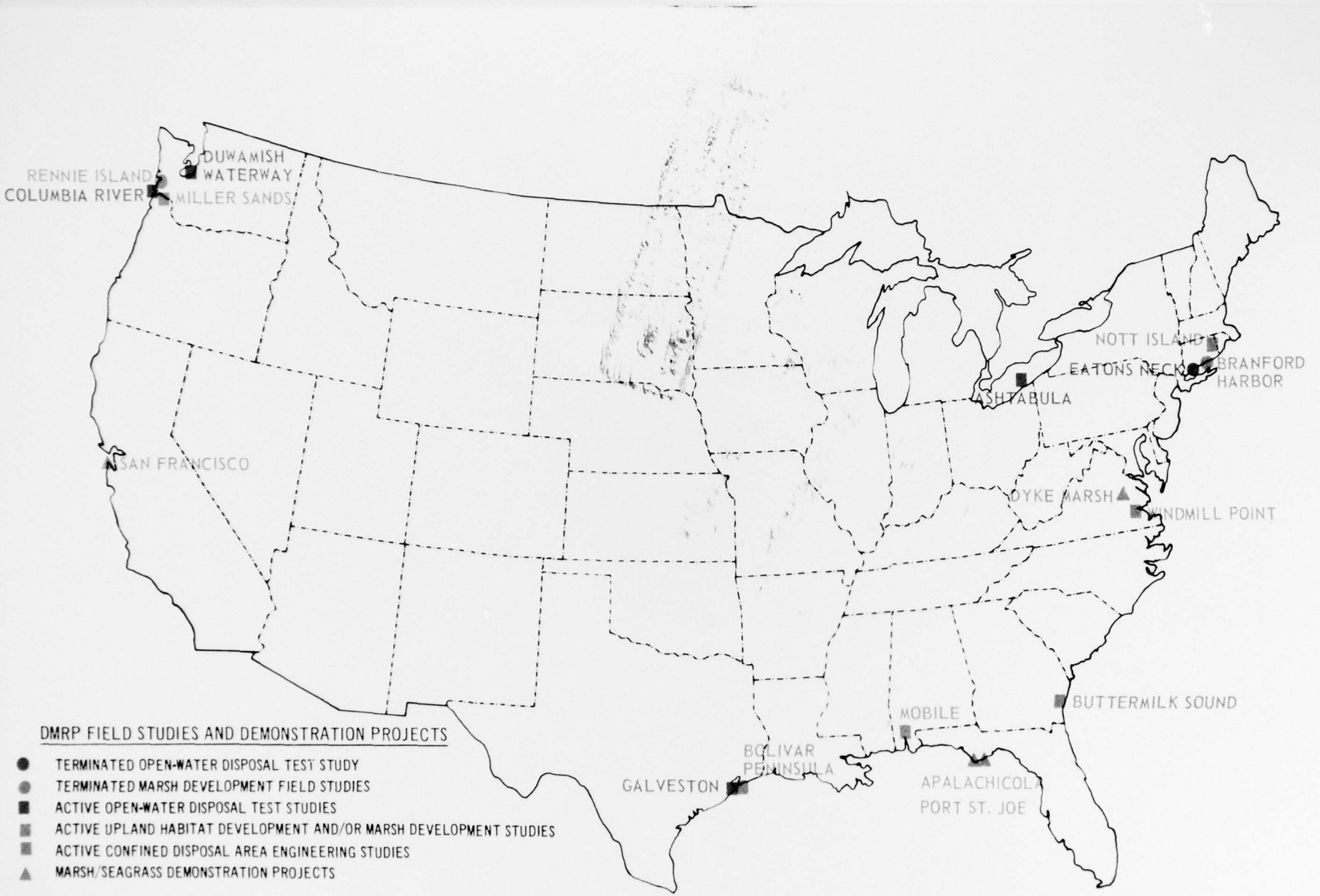
Local biologists chosen

Army awards A&I $84,383 gran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TERMINATED OPEN-WATER DISPOSAL TEST STUDY
TERMINATED MARSH DEVELOPMENT FIELD STUDIES
ACTIVE OPEN-WATER DISPOSAL TEST STUDIES
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